Econ 219B
Psychology and Economics: Applications
(Lecture 8)

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Outline

1. Social Pressure II: Charitable Giving II
2. Workplace: Gift Exchange
3. Charitable Giving: Gift Exchange
4. Signaling
5. Non-Standard Beliefs
6. Overconfidence
7. Law of Small Numbers

1 Social Pressure: Charitable Giving II

Continue **DellaVigna, List, and Malmendier (2012)**

- **Structural estimates (Minimum-distance estimator)**

- Minimize distance between predicted moments $m(\vartheta)$ and observed ones $\hat{m}$:

$$\min_{\vartheta} (m(\vartheta) - \hat{m})' W (m(\vartheta) - \hat{m})$$

- Moments $m(\vartheta)$:
  1. Probability of opening the door $(P(H)_j^c,\ j = F, NF, OO,\ c = LaR, Ecu)$
  2. Probability of checking opt-out box $(P(OO)_{OO}^c,\ c = LaR, Ecu)$
  3. Probability of giving at all, and giving an amount range $(P(G)_j^c,\ j = F, NF, OO,\ c = LaR, Ecu)$
  4. Probability of opening door in survey $(P(H)_j^S)$
  5. Probability of filling survey $(P(S)_j^S)$

- Weighting matrix W diagonal of inverse of variance-covariance matrix

- Parametric assumption to estimate the model:
  1. Consumption utility linear: $u(W-g) = W-g$
  2. Altruism function $av(g, G_{-i}) = a \log(G+g)$
  3. Altruism a is distributed $N(\mu, \sigma)$
  4. Acceptable donation $g^S = \$10$ (median)
  5. Cost function $c(h) = (h-h_0)^2/2\eta$
  6. No mail giving ($\theta = 0$)

- Marginal utility of giving: $a/(G+g) - 1$

- Parameters ϑ:
  1. h_0^{2008} and h_0^{2009}—probability of being at home in no-flyer conditions
  2. r—probability of observing and remembering the flyer
  3. η—responsiveness of the probability of being at home to the utility of being at home
  4. μ_a^c $(c = LaR, Ecu)$—mean of the distribution F of the altruism α
  5. σ_α^c $(c = LaR, Ecu)$—standard deviation of $F(\alpha)$
  6. G—curvature of altruism/warm glow function
  7. S^c $(c = LaR, Ecu)$—social pressure associated with not giving
  8. μ^S—mean of the distribution F^S from which the utility of the survey is drawn
  9. σ^S—standard deviation of F^S
  10. S^S—social pressure associated with saying no
  11. v^S—value of an hour of time completing a survey

- Identification:
  - Prob. being at home h_0 <– Control group
  - Prob. seeing flyer r <– Share opting out
  - Utility of doing survey μ^S and σ^S <– Share completing survey
  - Value of time v^S <– Comparison of effect of \$10 payment and 5 minute duration
  - Elasticity of home presence η <– Share opening door in survey for different payments + Giving in charity
  - Altruism parameters μ^c, σ^c, G <– Given η, share giving different amounts
  - Social pressure parameters S^i and S^S <– Share opening door and giving

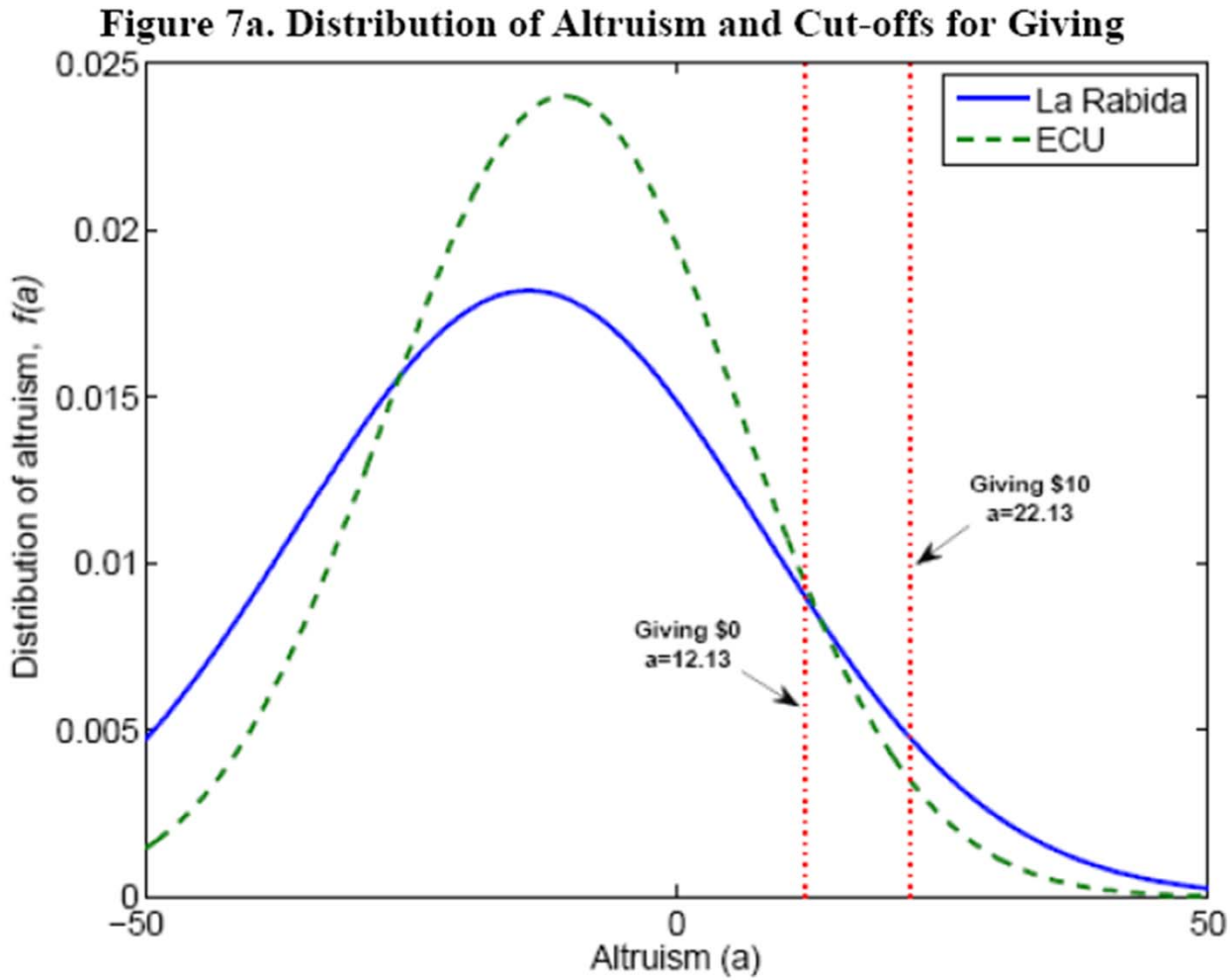
Appendix Table 1. Empirical Moments and Estimated Moments

Specification:	Minimum-Distance Estimates			
Charity	La Rabida Charity		ECU Charity	
Moments for Charity	Empirical Moments	Estimated Moments	Empirical Moments	Estimated Moments
Moments	(1)	(2)	(3)	(4)
P(Home) No Flyer	0.4130	0.4142	0.4171	0.4142
P(Home) Flyer	0.3733	0.3735	0.3806	0.3983
P(Home) Opt-Out	0.3070	0.2989	0.3281	0.2911
P(Opt Out) Opt-Out	0.1202	0.1142	0.0988	0.1179
P(Giving) No Flyer	0.0717	0.0666	0.0455	0.0422
P(Giving) Flyer	0.0699	0.0710	0.0461	0.0449
P(Giving) Opt-Out	0.0515	0.0633	0.0272	0.0390
Additional Moments (not shown)				
P(0<Giving<10), P(Giving=10), P(10<Giving<=20), P(20<Giving<=50), P(Giving>50) in Treatments NF, F, OO	X	X	X	X
N	N = 4962	N = 4962	N = 2707	N = 2707

Table 4. Minimum-Distance Estimates: Benchmark Results

	Benchmark Estimates		Estimates with Identity Weighting Matrix	
Common Parameters	(1)		(2)	
Prob. Answering Door (h) - Year 2008	0.414		0.414	
	(0.004)		(0.006)	
Prob. Answering Door (h) - Year 2009	0.449		0.445	
	(0.007)		(0.008)	
Prob. Observing Flyer (r)	0.322		0.302	
	(0.011)		(0.012)	
Elasticity of Home Presence (eta)	0.047		0.060	
	(0.014)		(0.031)	
Implied Cost of Altering Prob. Home by 10 pp.	0.106		0.083	
Survey Parameters				
Mean Utility (in $) of Doing 10-Minute Survey	-26.865		-26.936	
	(4.233)		(5.509)	
Std. Dev. of Utility of Doing Survey	30.285		30.332	
	(5.208)		(6.303)	
Value of Time of One-Hour Survey	74.580		76.761	
	(22.901)		(26.130)	
Social Pressure Cost of Saying No to Survey	4.784		3.869	
	(1.285)		(1.918)	
Charity Parameters	La Rabida	ECU	La Rabida	ECU
Mean Weight on Altruism Function (mu)	-13.910	-10.637	-13.586	-15.109
	(3.250)	(4.273)	(9.481)	(10.919)
Std. Dev. of Weight on Altruism Function	21.935	16.620	19.832	19.832
	(1.335)	(1.832)	(3.885)	(3.998)
Curvature of Altruism Function (G)	12.133		12.224	
	(5.147)		(15.518)	
Social Pressure Cost of Giving 0 in Person	3.550	1.364	3.140	1.906
	(0.615)	(0.744)	(1.674)	(1.475)

Implied distribution of altruism

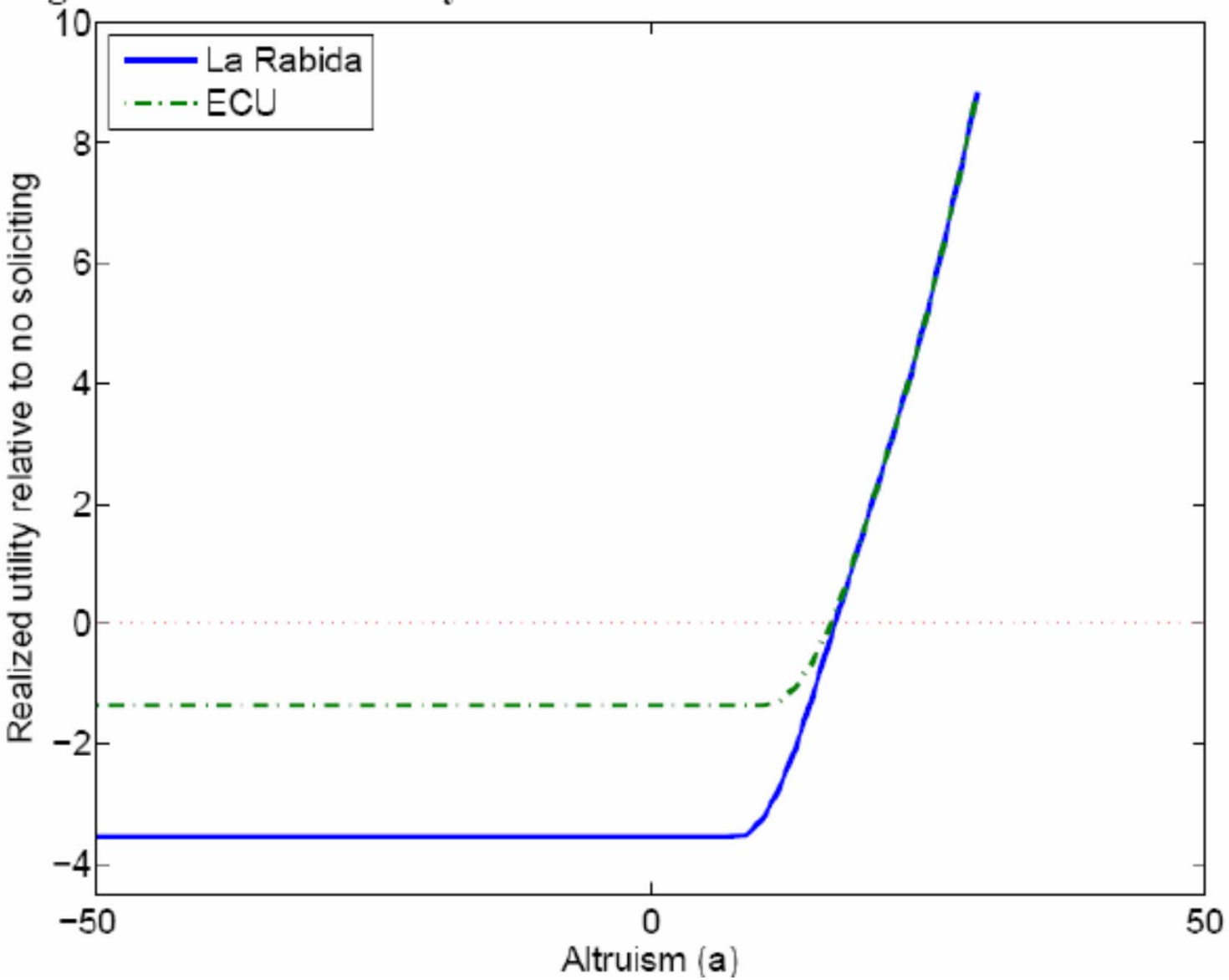


Marginal utility of giving (for $S = 0$) is $a/(G+g)-1$

Hence, give $g > 0$ if $a > G=12.13$

Welfare: Does a fund-raiser increase utility for the giver?

Figure 7b. Overall Utility of Fund-Raiser as function of Altruism



Welfare

1. Low-altruism households pay social pressure cost
2. High-altruism households get benefit
3. Since the former dominate, on net negative welfare for solicitee

Panel C. Welfare	**La Rabida Charity**	**ECU Charity**
Welfare in Standard (No-Flyer) Fund-Raiser		
Welfare per Household Contacted (in $)	-1.077 (0.160)	-0.439 (0.286)
Money Raised per Household Contacted	0.722 (0.036)	0.332 (0.046)
Money Raised per Household, Net of Salary	0.247 (0.036)	-0.143 (0.046)

- Societal welfare effect can still be positive if money used very well
  But amount of money raised small (negative for ECU)

Flyer and opt-out treatment increase solicitee welfare

- Can also raise charity welfare (i.e., net fund-raising)

Panel C. Welfare	**La Rabida Charity**	**ECU Charity**
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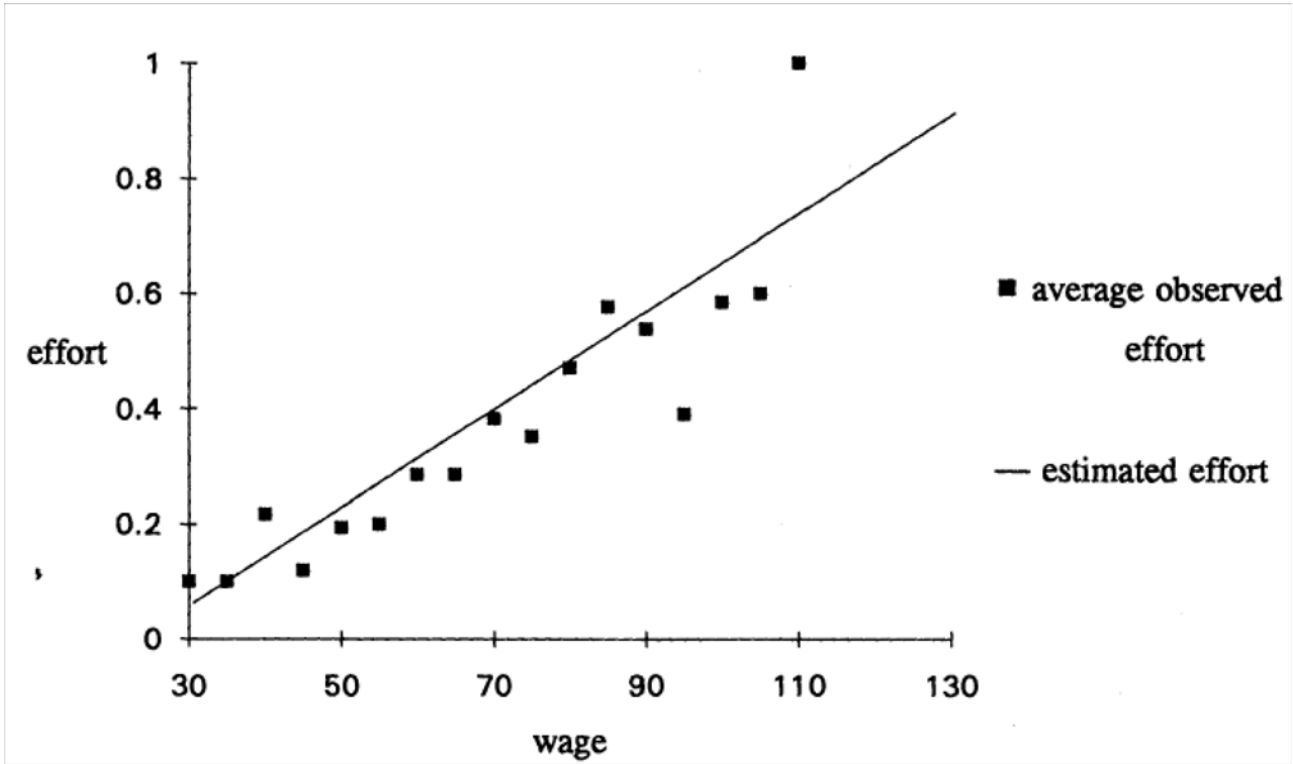
Welfare per Household Contacted (in $)	-1.077 (0.160)	-0.439 (0.286)
Money Raised per Household Contacted	0.722 (0.036)	0.332 (0.046)
Money Raised per Household, Net of Salary	0.247 (0.036)	-0.143 (0.046)
Welfare in Fund-Raiser with Flier		
Welfare per Household Contacted (in $)	-0.924 (0.145)	-0.404 (0.273)
Money Raised per Household Contacted	0.859 (0.044)	0.333 (0.046)
Money Raised per Household, Net of Salary	0.248 (0.044)	-0.278 (0.046)
Welfare in Fund-Raiser with Opt-out		
Welfare per Household Contacted (in $)	-0.586 (0.085)	-0.248 (0.196)
Money Raised per Household Contacted	0.810 (0.045)	0.369 (0.055)
Money Raised per Household, Net of Salary	0.294 (0.036)	-0.147 (0.046)

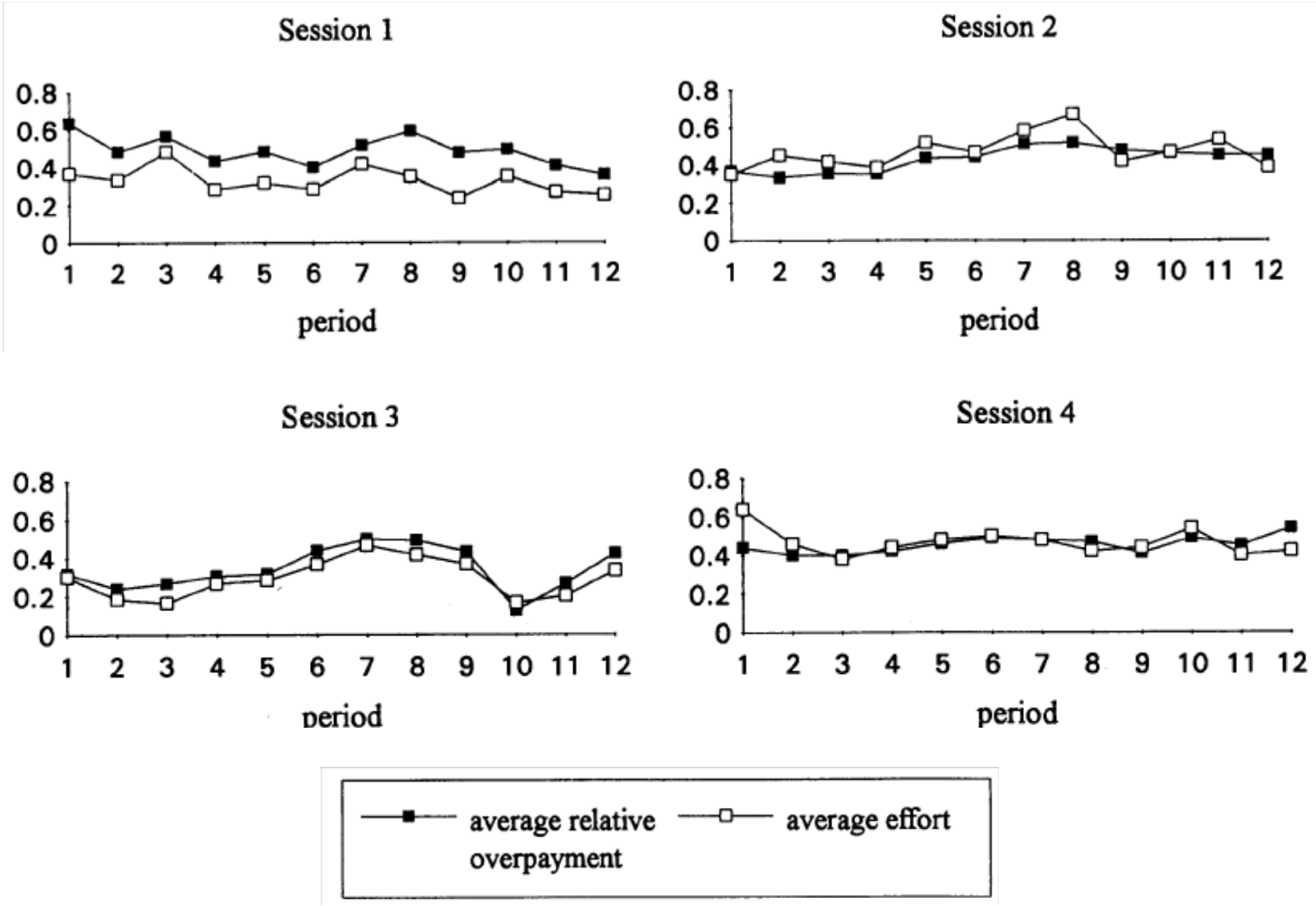
2 Workplace: Gift Exchange

- Laboratory evidence: **Fehr-Kirchsteiger-Riedl (QJE, 1993).**
  - 5 firms bidding for 9 workers
  - Workers are first paid $w \in \{0, 5, 10, ...\}$ and then exert effort $e \in [.1, 1]$
  - Firm payoff is $(126 - w)\, e$
  - Worker payoff is $w - 26 - c(e)$, with $c(e)$ convex (but small)
- Standard model: $w^* = 30$ (to satisfy IR), $e^*(w) = .1$ for all w

- Findings: effort e increasing in w and $Ew = 72$



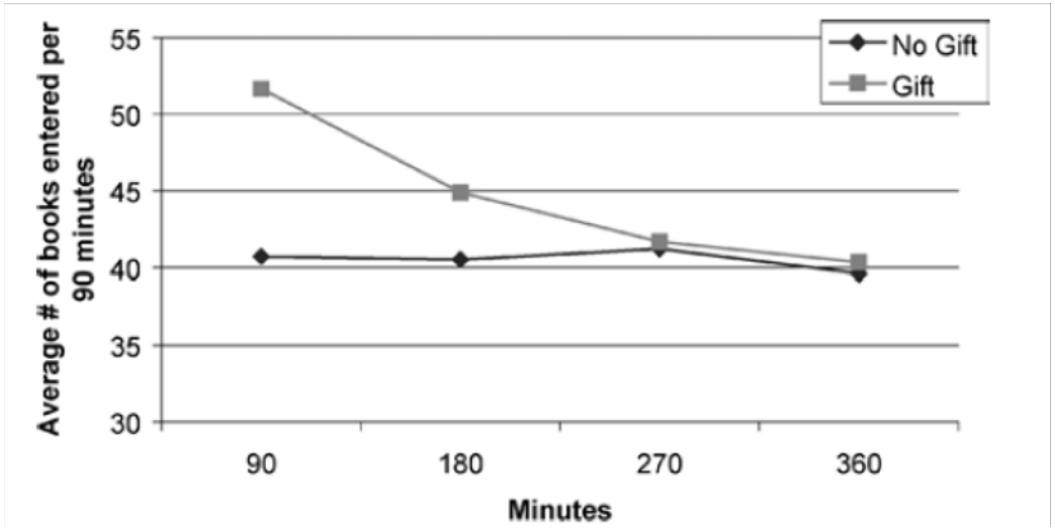
- These findings are stable over time


Session 1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12
period
Session 2
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12
period
Session 3
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12
period
Session 4
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12
period
average relative overpayment
average effort

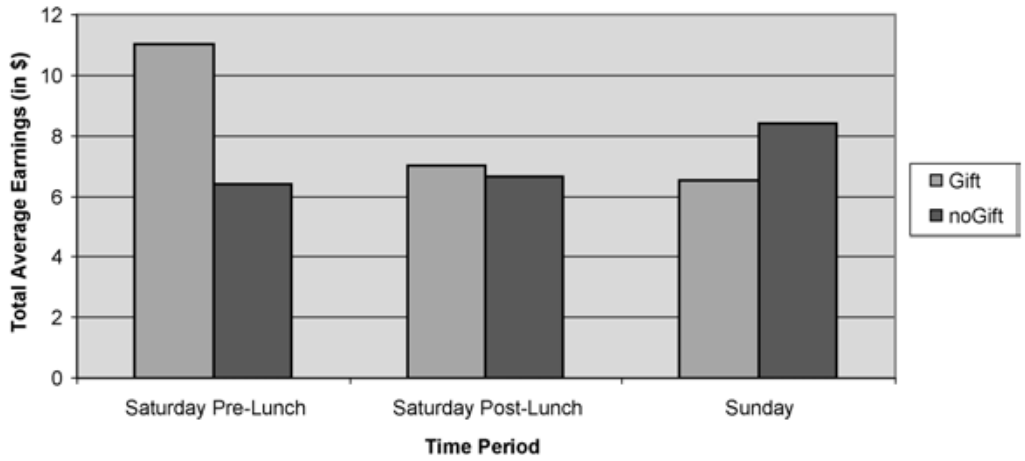
- Which model explains this behavior?
- Fehr-Schmidt (1999) propose: *Inequity aversion* ($\rho > 0 > \sigma$)
  - Initially, firm is ahead in payoffs
  - Assume firm pays minimum wage
    - Firm still ahead in payoffs
    - Worker does not care for firm given $\sigma < 0$
    - –> Worker does not want to exert effort to benefit the firm
  - Assume now firm pays generous wage towards worker
    - Firm is *now* behind in payoffs
    - Worker now cares for firm given $\rho > 0$
    - —> Worker exerts effort to decrease (advantageous) inequality
  - The higher the wage, the larger the transfer given mechanism above

- Alternative model: *Reciprocity*
  - Worker cares about firm with weight α
  - Altruism weight is a function of how nicely workers has been treated
  - Positive gift increases α
  - —> Worker puts more effort because he cares more about firm
  - The higher the wage, the larger the transfer given mechanism above

- Evidence of gift exchange in a field workplace?
- **Gneezy-List (EMA, 2006)** –> Evidence from labor markets
- *Field experiment 1.* Students hired for one-time six-hour (typing) library job for \$12/hour
  - No Gift group paid \$12 ($N = 10$)
  - Gift group paid \$20 ($N = 9$)



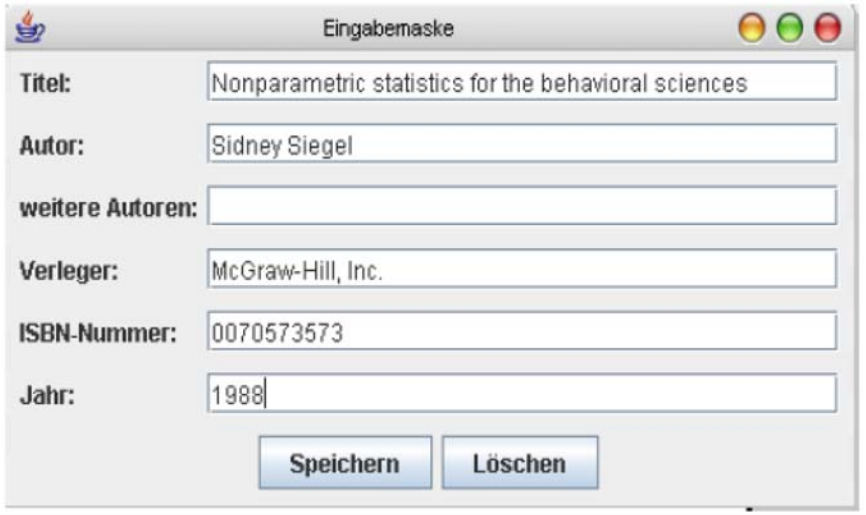
- *Field experiment 2.* Door-to-Door fund-raising in NC for one-time weekend for \$10/hour
  - Control group paid \$10 ($N = 10$)
  - Treatment group paid \$20 ($N = 13$)



- Note: Group coming back on Sunday is subset only (4+9)
- Evidence of reciprocity, though short-lived

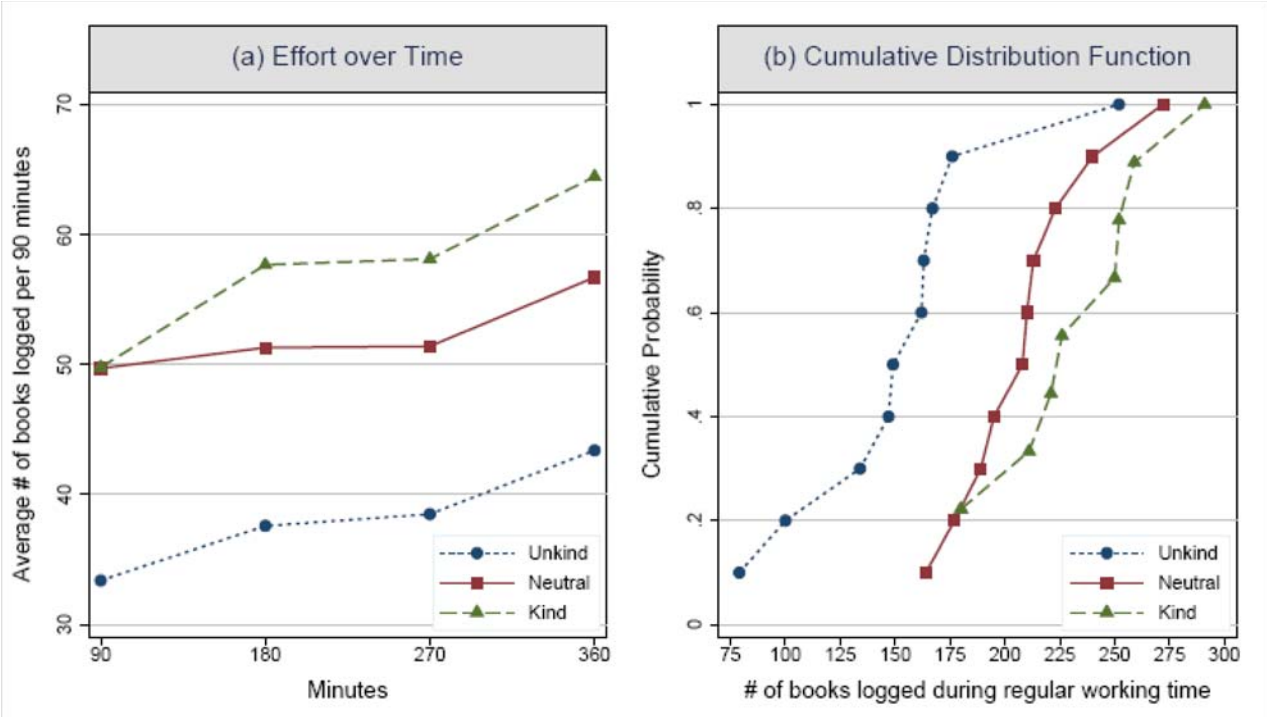
- Laboratory evidence: negative reciprocity stronger than positive reciprocity
- Test for positive versus negative reciprocity in the field?
- **Kube-Marechal-Puppe (JEEA 2013).**
- Field Experiment: Hire job applicants to catalog books for 6 hours

Figure 2: Screenshot: Computer Application



- Announced Wage: '*Presumably*' 15 Euros/hour
  - Control ($n = 10$). 15 Euros/hour
  - Treatment 1 (Negative Reciprocity, $n = 10$). 10 Euros/hour (No one quits)
  - Treatment 2 (Positive Reciprocity, $n = 9$). 20 Euros/hour
- Offer to work one additional hour for 15 Euros/hour

- Result 1: Substantial effect of pay cut
- Result 2: Smaller effect of pay increase
- Result 3: No decrease over time

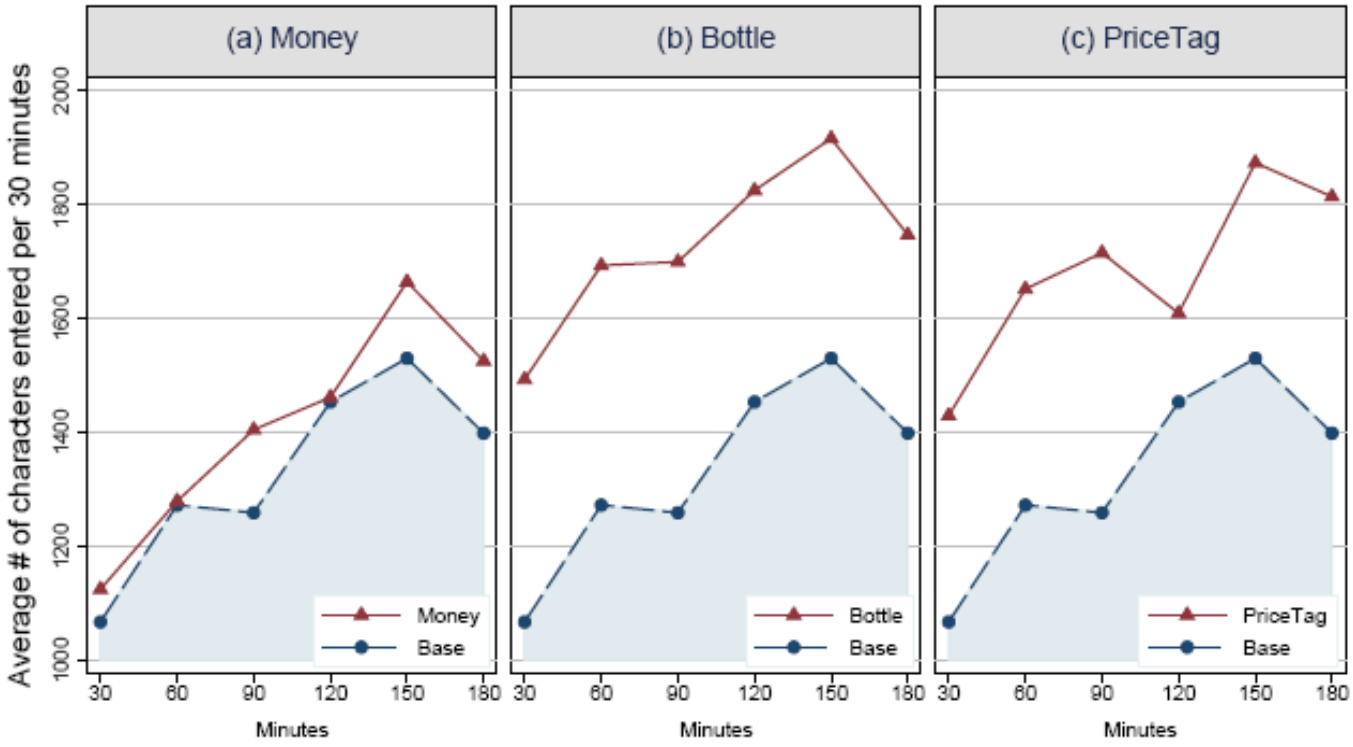


- Finding consistent with experimental results:
  - Positive reciprocity weaker than negative reciprocity
- Important other result:
  - No negative effect on quality of effort (no. of books incorrectly classified)
  - All treatments have near perfect coding
  - Hence, negative reciprocity does not extend to sabotage
- Final result: No. of subjects that accept to do one more hour for 15 Euro:
  - 3 in Control, 2 in Pos. Rec., 7 in Neg. Rec.
  - Positive Reciprocity does not extend to volunteering for one more hour

- **Kube-Marechal-Puppe (AER 2011).**
- Field Experiment 2: Hire job applicants to catalog books for 6 hours
- Announced Wage: 12 Euros/hour for 3 hours=36
  - Control ($n = 17$). 36 Euros
  - Treatment 1 (Positive Reciprocity, Cash, $n = 16$). $36 + 7 = 43$ Euros
  - Treatment 2 (Positive Reciprocity, Gift, $n = 15$). 36 Euros plus Gift of Thermos
  - Treatment 3 – Same as Tr. 2, but Price Tag for Thermos

- What is the effect of cash versus in-kind gift?

- Result 1: Small effect of 20% pay increase
- Result 2: Large effect of Thermos –> High elasticity, can pay for itself
- Result 3: No decrease over time



- Explanation 1. Thermos perceived more valuable
  - –> But Treatment 3 with price tag does not support this
  - Additional Experiment:
    - At end of (unrelated) lab experiment, ask choice for 7 Euro or Thermos
    - 159 out of 172 subjects prefer 7 Euro
- Explanation 2. Subjects perceive the thermos gift as more kind, and respond with more effort
- Tentative conclusions from gift exchange experiments:
  1. Gift exchange works in lab largely as in field
  2. Negative reciprocity stronger than positive reciprocity (as in lab)
  3. Effect is sensitive to perception of gift

- BUT: Think harder about these conclusions using **models**
- **Conclusion 1.** Gift exchange works in lab as in field
- Fehr, Kirchsteiger, and Riedl (QJE, 1993) - Two main model-based explanations:
  - *Inequity Aversion* (Fehr and Schmidt, 1999): Worker puts effort because firm had fallen behind in payoffs by putting effort
  - *Reciprocity* (Rabin, 1993; Dufwenberg and Kirchsteiger, 2003): Worker is nice towards firm because firm showed nice intentions
- Model for Gneezy and List (2006) and follow-up work?
  - Inequity aversion does *not* predict gift exchange in the field (Card, DellaVigna, and Malmendier, JEP 2011)

- Firm is very likely to have substantial income M, more than worker
- When firm transfers gift to employee, firm is still ahead on payoffs
- –> No predicted effort response
- Intuition: Firm does not fall behind the worker just because of a pay increase

- Hence, gift exchange in the field, when occurs, is due to reciprocity, not inequity aversion

- **Conclusion 2.** Negative reciprocity stronger than positive reciprocity
  - Is that really implied?
- Pure-altruism model of utility maximization of worker in gift exchange experiment

$$\max_e u(e) = w - c(e) + \alpha\left[ve - w\right]$$

  - e is effort, measurable
  - w is fixed payment (could be a gift)
  - $c\left(e\right)$ is cost of effort
  - α is altruism coefficient
  - v is return to the firm for unit of effort
- Would like to estimate α, and how it changes when a gift is given

- Utility

$$\max_e u(e) = w - c(e) + \alpha\left[ve - w\right]$$

- First-order condition:

$$-c'\left(e^*\right) + \alpha v = 0$$

- Can we estimate α?

- Two key unobservables:
  - Value of work v: What is the value of one library book coded?
  - Cost of effort $c\left(e\right)$: How hard it is to work more on the margin?

- Second issue confounds conclusion on reciprocity
  - Positive reciprocity may be stronger than negative, but marginal cost of effort steeply increasing –> Find stronger response to negative gift

- **DellaVigna, List, Malmendier, and Rao (2016)**
  - Address Issue 1 by informing of value of work to employer
  - Address Issue 2 by estimating cost of effort function with piece rate variation
  - Only then introduce gift treatments
- Introduce piece rate in design. Utility

$$\max_e u(e) = w + pe - c(e) + \alpha \left[ve - pe - w\right]$$

- First-order condition:

$$p - c'\left(e^*\right) + \alpha \left[v - p\right] = 0$$

  - Notice

$$\frac{\partial e^*}{\partial p} = -\frac{1-\alpha}{-c''\left(e\right)}$$

and

$$\frac{\partial e^*}{\partial v} = -\frac{\alpha}{-c''(e)}$$

– Hence, can estimate α given

$$\frac{\partial e^*}{\partial v} \Big/ \frac{\partial e^*}{\partial p} = \frac{\alpha}{1-\alpha}$$

- We vary piece rate p as well as return v

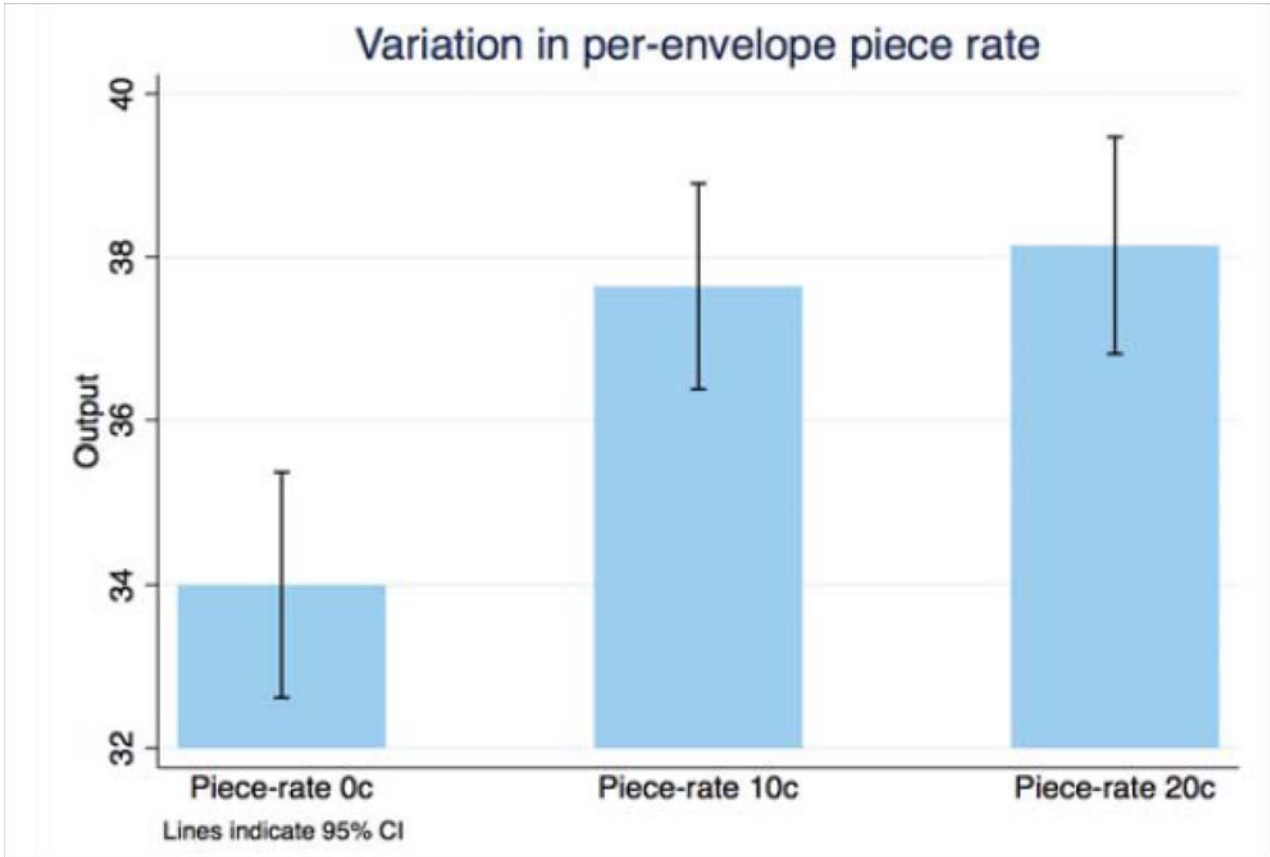
- Logistics:
  - Recruit for a one-time, 5-hour job
  - Task is to fold letters, stuff into appropriate envelope, and attach mailing address
  - Task is simple, but not implausible for a temp worker
  - Workers are working for a charity which pays them X per envelope
  - Workers are told the (expected) return Y to the charity
  - Example: "The envelopes filled in this session will be used in a letter campaign of Breakthrough. As mentioned before, Breakthrough will be paying for your work. The pay is $0.20 per envelope completed, as noted on your schedule. A number of such campaigns have been run by charities similar to Breakthrough, and historically, these charities

have gotten roughly $0.30 per mailer with such campaigns. Taking account of Breakthrough per-envelope payment for your help today, it expects to get roughly $0.10 for each additional envelope that you prepare during this session."

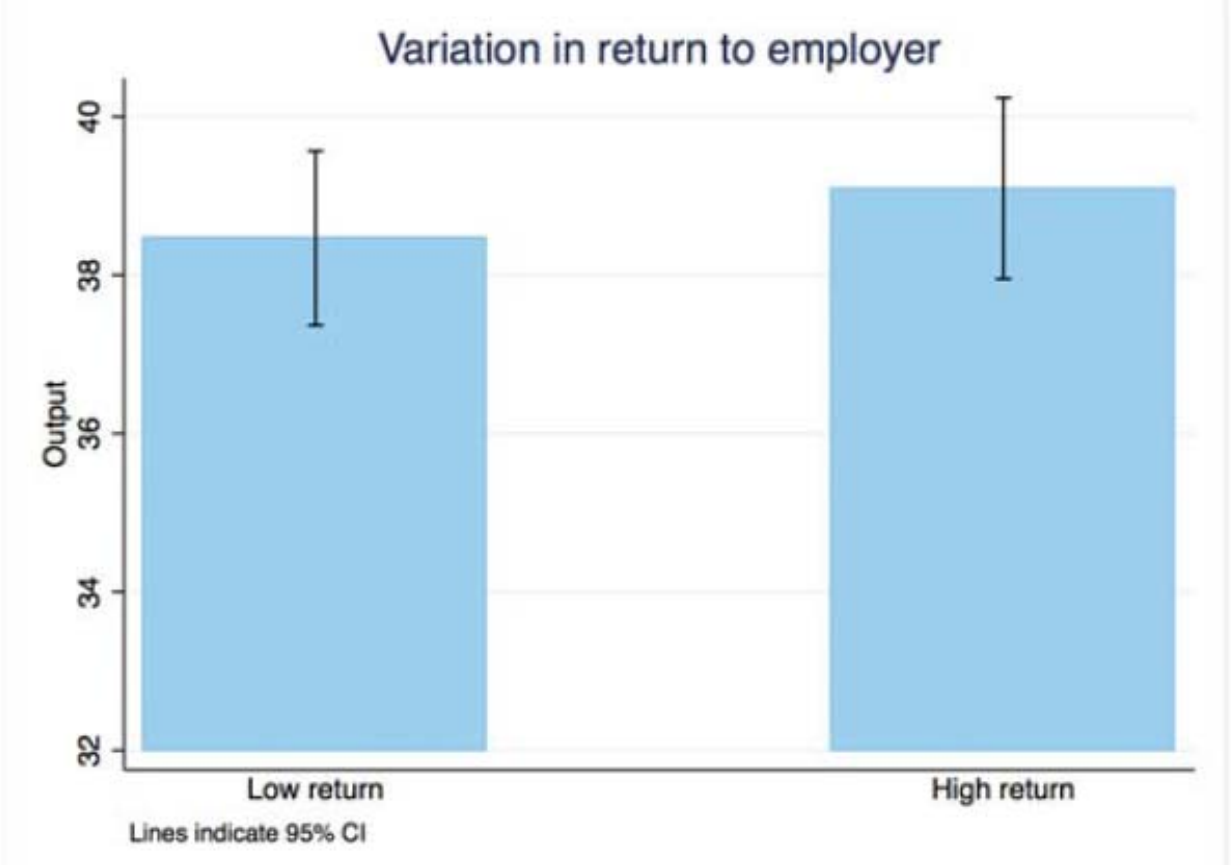
- To estimate cost of effort, we vary the piece rate within person
  - Ten 20-minute periods of folding envelopes with 5 min breaks
  - We vary the piece rate X (0 cents vs. 10 cents vs. 20 cents)
  - We vary the return to charity Y (30 cents vs. 60 cents)
  - We introduce training sessions where output is discarded
  - Subjects work for three different charities (and a firm)
- In last 2 periods, we introduce a gift

- Control group – paid $7 flat pay as before
- Positive gift – paid $14
- Negative gift – paid $3
- Gift sessions are observed both with high and low return to firm
- This design allows us to estimate all parameters

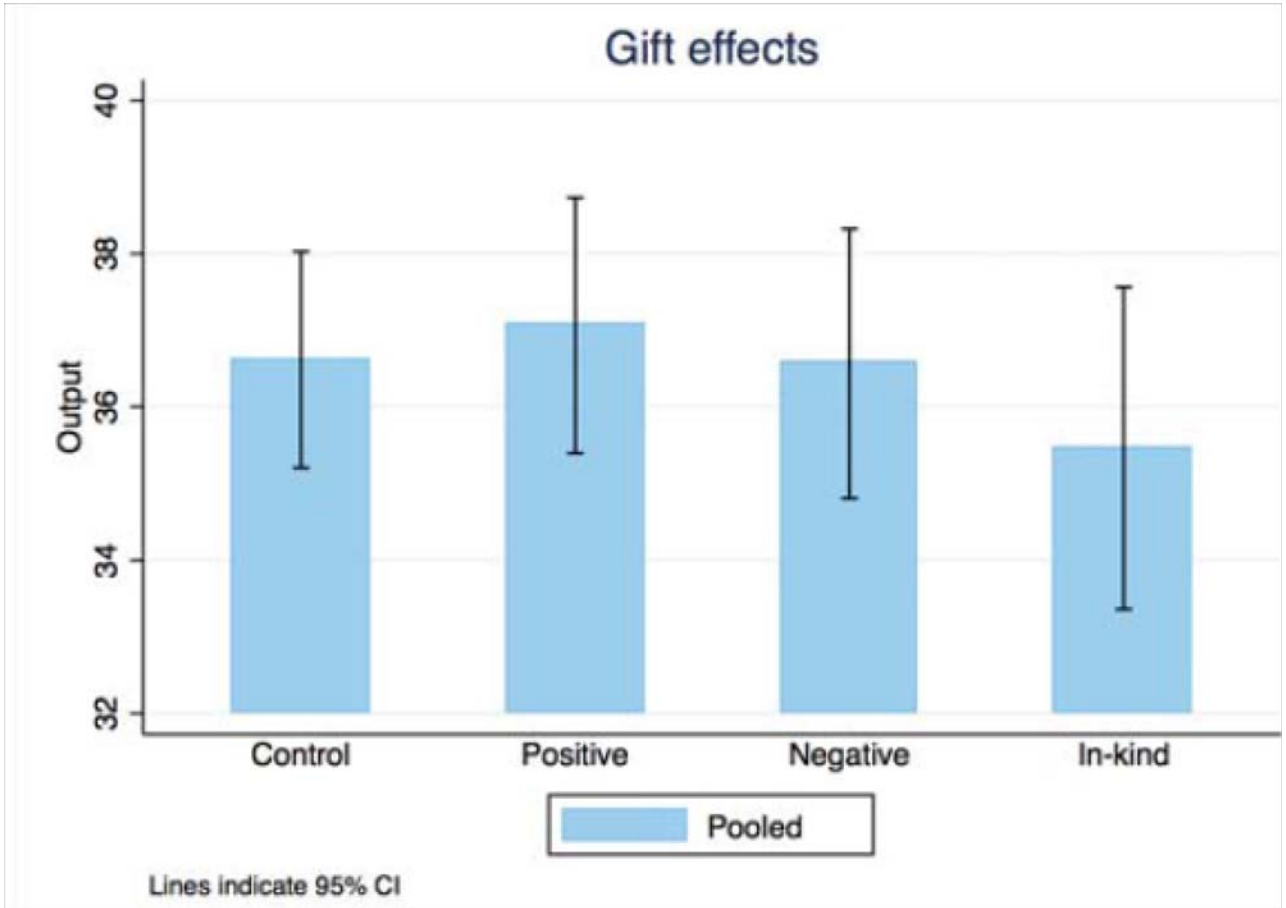
- Finding 1. Significant response to piece rate



- Finding 2. Very small impact of match

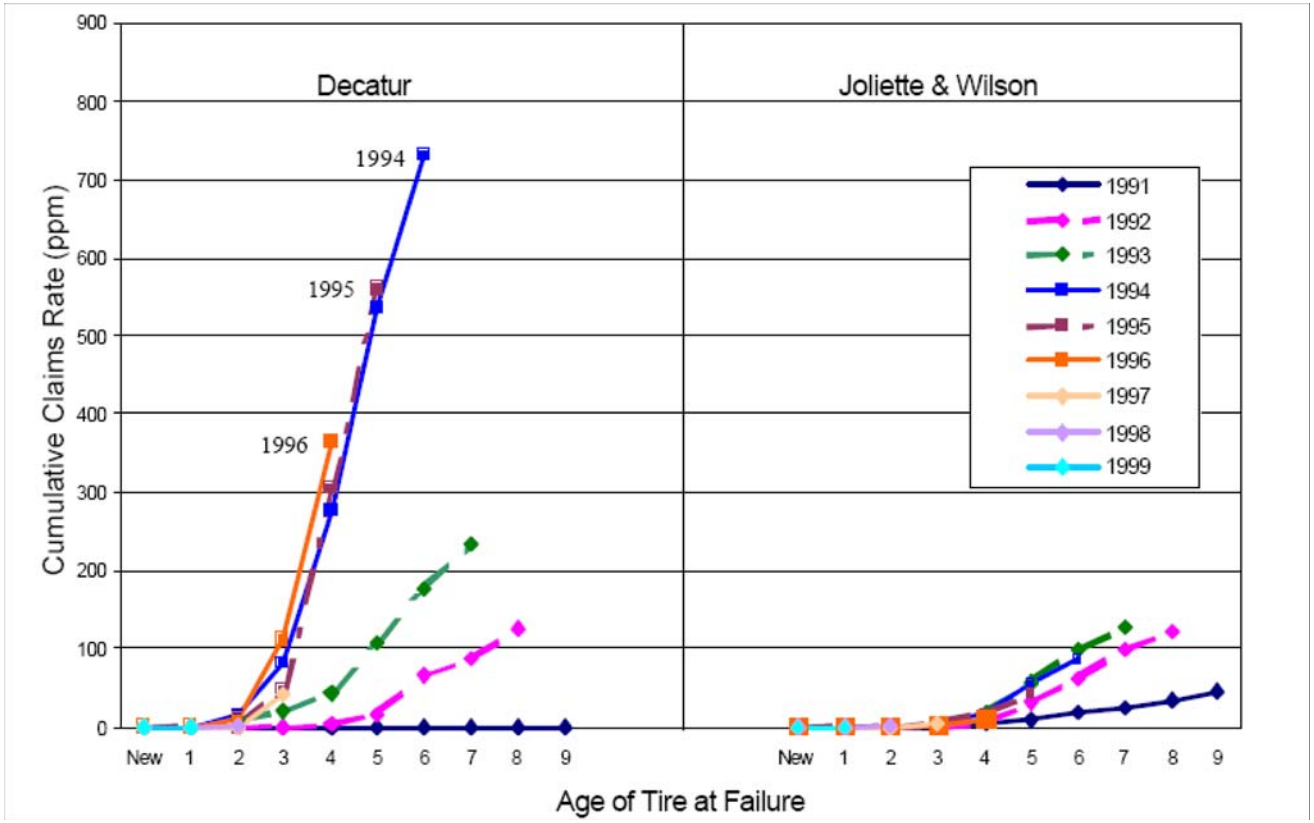


- Finding 3. No significant impact of any of the gifts



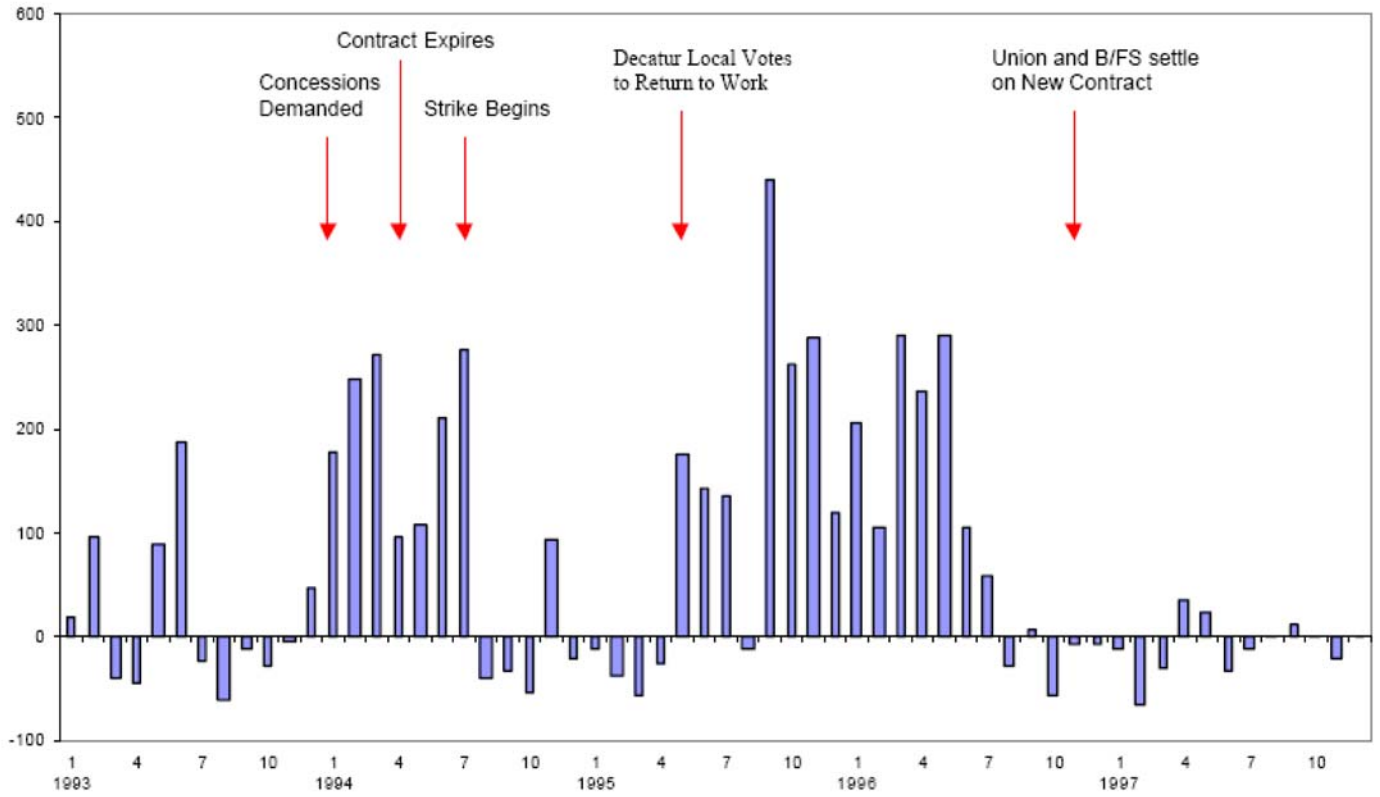
- Is there evidence in a workplace of negative reciprocity towards unkind employer leading to sabotage?
- **Krueger-Mas (JPE, 2004).**
- Setting:
  - Unionized Bridgestone-Firestone plant
  - Workers went on strike in July 1994
  - Replaced by replacement workers
  - Union workers gradually reintegrated in the plant in May 1995 after the union, running out of funds, accepted the demands of the company
  - Agreement not reached until December 1996

- Do workers sabotage production at firm?
  - Examine claims per million tires produced in plants affected
  - Compare to plant not affected by strike (Joliette&Wilson)



- Ten-fold increase in number of claims
- Similar pattern for accidents with fatalities
- Possible explanations:
  - Lower quality of replacement workers
  - Boycotting / negative reciprocity by unionized workers
- Examine the timing of the claims

Figure 8: Difference in the Number of Complaints per million Tires Produced by Month: Decatur Plant minus Joliette and Wilson Plants.



Source: Authors' calculations based on NHTSA complaints data. Records with missing data are excluded.

- Two time periods with peak of claims:
  - Beginning of Negotiation Period
  - Overlap between Replacement and Union Workers
- Quality not lower during period with replacement workers
- Quality crisis due to Boycotts by union workers
- Claims back to normal after new contract settled
- Suggestive of extreme importance of good employer-worker relations

3 Charitable Giving: Gift Exchange

- **Falk (EMA, 2008)** — field experiment in fund-raising
  - 9,846 solicitation letters in Zurich (Switzerland) for Christmas
  - Target: Schools for street children in Dhaka (Bangladesh)
  - 1/3 no gift, 1/3 small gift 1/3 large gift
  - Gift consists in postcards drawn by kids
  - Do gifts trigger higher generosity?

Appendix: An example of the included postcards

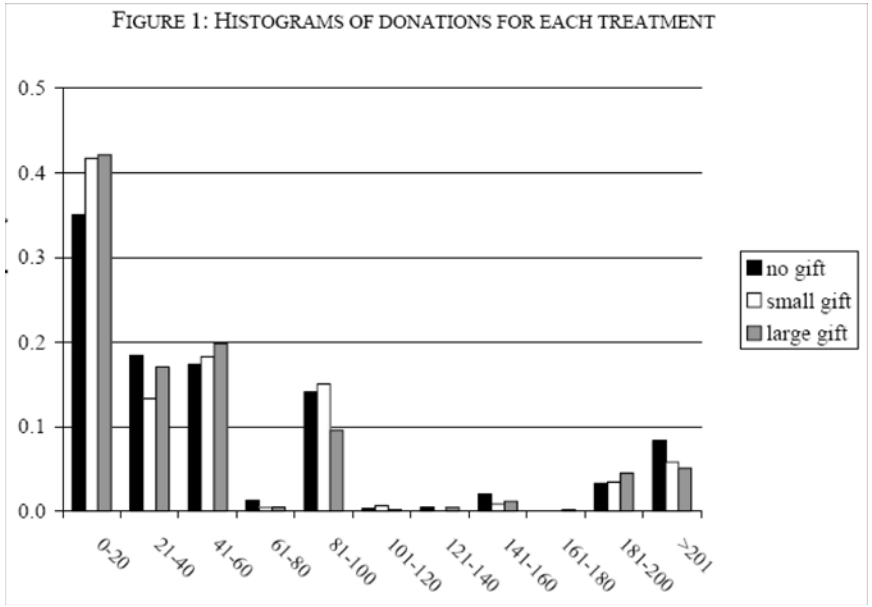
- Short-Run effect: Donations within 3 months

TABLE 1: DONATION PATTERNS IN ALL TREATMENT CONDITIONS

	No gift	Small gift	Large gift
Number of solicitation letters	3,262	3,237	3,347
Number of donations	397	465	691
Relative frequency of donations	0.12	0.14	0.21

- Large gift leads to doubling of donation probability
- Effect does not depend on previous donation pattern (donation in previous mailing)
- Note: High donation levels, not typical for US

- Small decrease in average donation, conditional on donation (Marginal donors adversely selected, as in 401(k) Active choice paper)



- Limited intertemporal substitution. February 2002 mailing with no gift. Percent donation is 9.6 (control), 8.9 (small gift), and 8.6 (large gift) (differences not significant)

4 Signaling

- **Signalling (Bodner and Prelec, 2002, Benabou and Tirole, 2004, 2006)**
  - Ego utility from thinking of self as generous
  - Individuals are unsure of (forget) their type
  - Infer type from own behavior in Bayesian way
  - Take into account signaling game in their actions
  - (Signaling can be to self or others)
- Idea:
  - Individuals may behave pro-socially to signal to self (or others) that they are generous type
  - Generates prediction of pro-social behavior (like other models)

  - Unique prediction: behave less pro-socially if pro-social behavior is less diagnostic of generosity
  - Crow-out of Intrinsic motivation (Deci 1971)

- Nice features:
  - Micro-founded: Bayesian updating, signaling
  - Ego utility very plausible

- Problems:
  - Hard to solve
  - Multiple equilibria possible
  - Hard to separate self-signaling from signaling to others

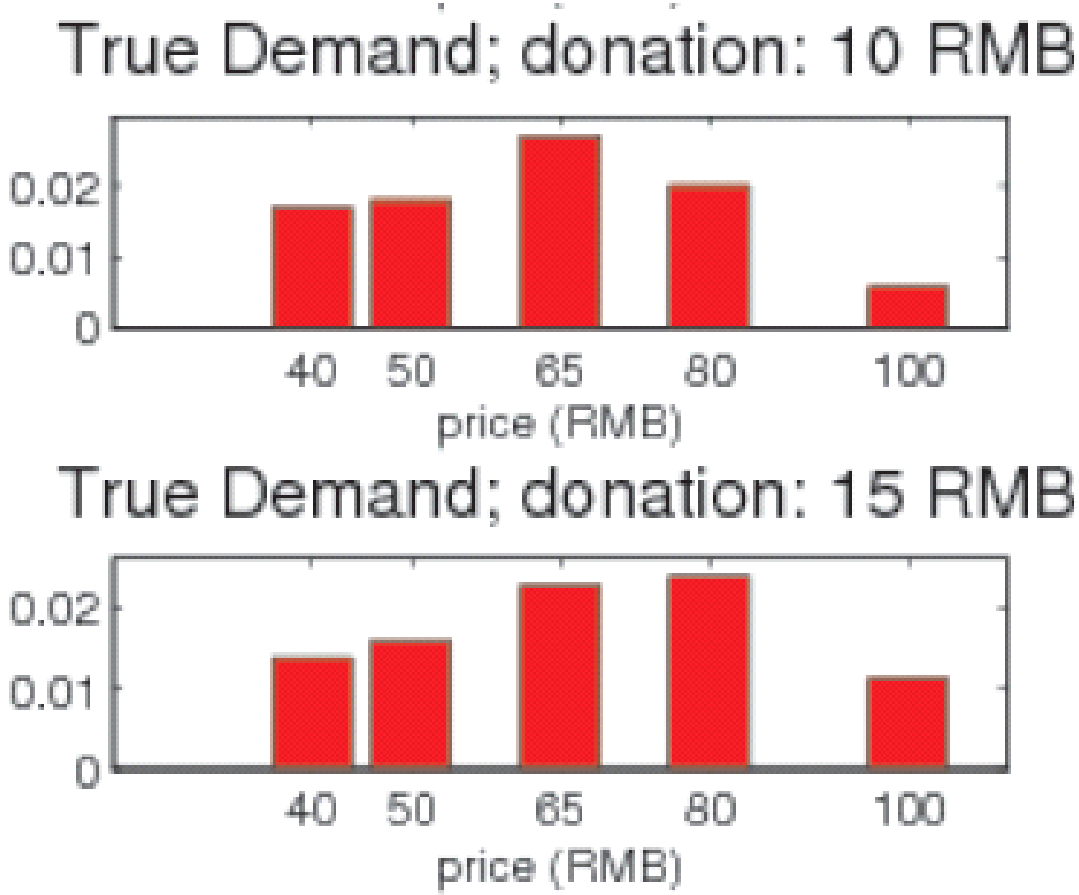
- Consider this in the context of **Dube, Luo, and Fang (2015)** paper on case-baed marketing
  - Send 30,000 SMS messages in China offering to buy movie ticket for 3-D version of *X-Men: Day of Future Past*
  - Standard price: 100 RMB
  - Randomize price discount: 0, 20, 35, 50, 60, 75 RMB
  - Cross-randomize charitable giving bundled with movie ticker purchase: "If you purchase ticket, X RMB will go to charity': 0, 5, 10, 15 RMB
  - Follow-up survey on motivation

- Sample sizes

Variable	Donation (RMB)				
discount (RMB)		0	5	10	15
	0	700	700	700	700
	20	700	1,000	1,000	1,000
	35	700	1,000	3,000	3,000
	50	700	1,000	3,000	3,000
	60	700	1,000	3,000	3,000
	75	700	-	-	-

- For low donation, monotonic effect of discount

- For high donation, non-monotonic effect of discount –> Crowd-out of motivation



- Striking result: Interpretation?
- Model adapted from Benabou-Tirole
- Part 1: Individual has consumption utility

$$V + \alpha p + \gamma a$$

  - V is utility from movie,
  - p is price of movie, α (<0) is price elasticity
  - a is donation, γ is (reduced-form) altruism
  - So far, standard model with altruism
- Part 2a: Ego utility on altruism:

$$\lambda_\alpha E\left(\alpha | a, p, y\right)$$

  - Individual derives utility from thinking of being altruistic (high a)

- Weight on ego utillity is λ_a: for $\lambda_a = 0$, back to pure altruism case
- Individual solves a signaling game to infer α given price p, discount a, and donation decision $y \in 0, 1$
- Thus, donation ($y = 1$) has ego utility benefits, rasing $E\alpha$

- This is not enough: need Part 2b in Ego utility:

$$\lambda_\gamma E\left(\gamma|a,p,y\right)$$

  - Individual derives utility from thinking of self as stingy – or not
  - Why this term? There needs to be a signal extraction problem: giving can signal high generosity or low price elasticity
  - Unattractive part of Benabou and Tirole model

- Decision: Give $(y = 1)$ if

$$\begin{aligned} U(1) &= V + \alpha p + \gamma a + \lambda_\alpha E(\alpha|a, p, 1) + \lambda_\gamma E(\gamma|a, p, 1) \geq \\ U(0) &= \lambda_\alpha E(\alpha|a, p, 0) + \lambda_\gamma E(\gamma|a, p, 0) \end{aligned}$$

  or

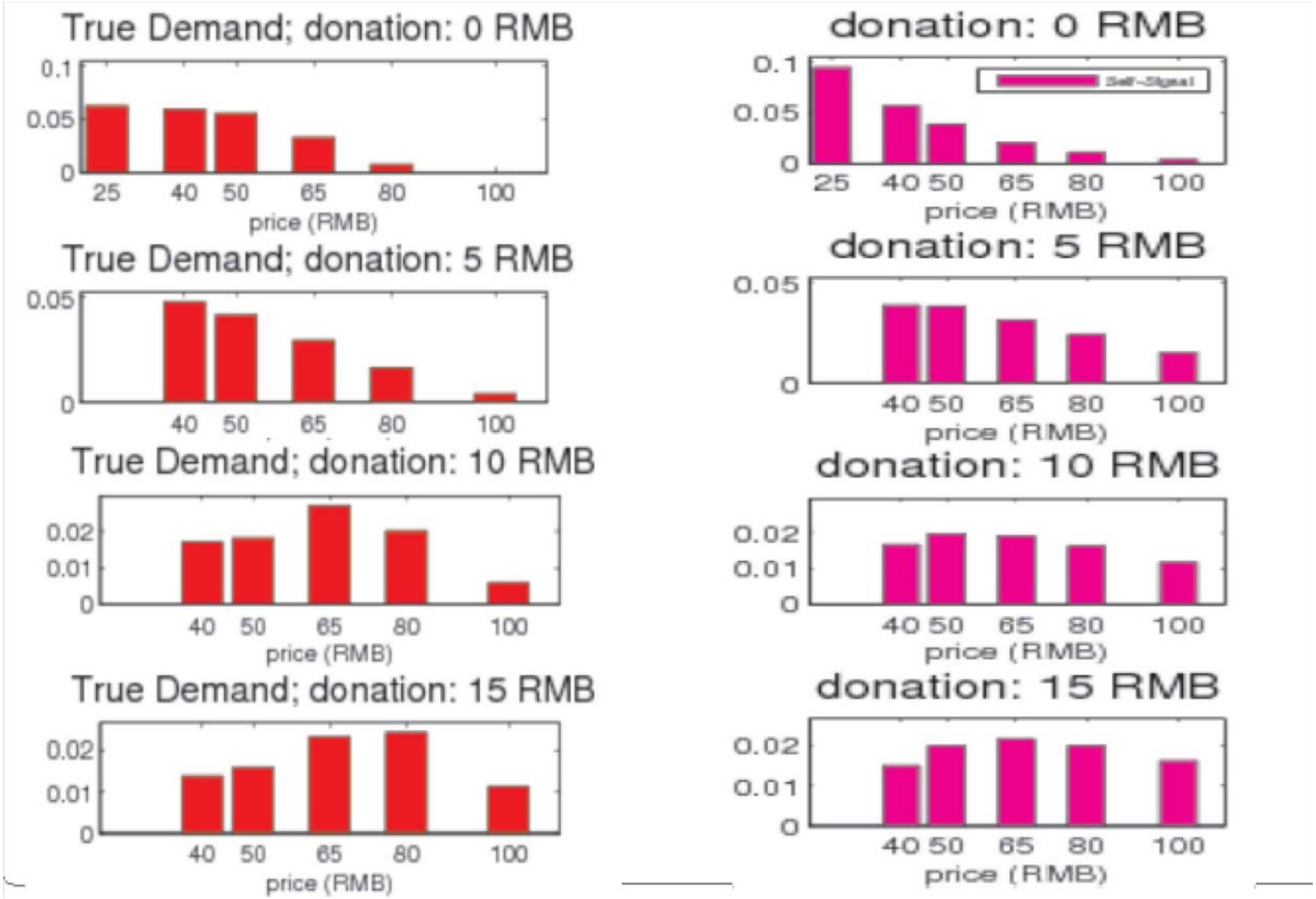
$$V + \alpha p + \gamma a + \Delta(a, p) > 0$$

  where Δ is net ego utility

- Updating on γ if purchase $(y = 1)$:

$$E\left(\gamma|\gamma > -\frac{V + \alpha p + \Delta(a, p)}{a}\right)$$

- Specify priors on parameters to derive separating equilibrium of signalling game


True Demand; donation: 0 RMB
0.1
0.05
0
25 40 50 65 80 100
price (RMB)
True Demand; donation: 5 RMB
0.05
0
40 50 65 80 100
True Demand; donation: 10 RMB
0.02
0.01
0
40 50 65 80 100
price (RMB)
True Demand; donation: 15 RMB
0.02
0.01
0
40 50 65 80 100
price (RMB)
donation: 0 RMB
0.1
0.05
0
25 40 50 65 80 100
price (RMB)
donation: 5 RMB
0.05
0
40 50 65 80 100
price (RMB)
donation: 10 RMB
0.02
0.01
0
40 50 65 80 100
price (RMB)
donation: 15 RMB
0.02
0.01
0
40 50 65 80 100
price (RMB)

- Remarkably good fit, but value of some parameters odd

- Relatedly: How much do you need ego utility on price elasticity: not obvious to interpret

$$\lambda_\gamma E\left(\gamma|a,p,y^h\right)+\lambda_\alpha E\left(\alpha|a,p,y^h\right)$$

- Relatedly: Estimation of some parameters appears problematic
  - Value V of good negative on average?

(What if allow for not all to pay attention)

  - σ_α is at boundary

	coefficient	st. error
Donation ($\bar{\gamma}$)	-0.1411	0.1345
Price, (α)	-0.0183	0.0077
Intercept, ($\bar{V}$)	-0.8526	0.225
σ_γ	0.1327	0.0632
σ_α	0.0001	0.307
λ_γ	2.1948	0.7931
λ_α	-15.9831	3.452

5 Non-Standard Beliefs

- So far, focus on non-standard utility function $U\left(x_i^t|s_t\right)$ as deviations from standard model:

$$\max_{x_i^t \in X_i} \sum_{t=0}^{\infty} \delta^t \sum_{s_t \in S_t} p\left(s_t\right) U\left(x_i^t|s_t\right)$$

- Non-standard preferences
  - Self-Control Problems (β, δ)
  - Reference Dependence $(U\left(x_i^t|s_i, r\right))$
  - Social Preferences $(U\left(x_i, x_{-i}|s\right))$

- Today: Non-Standard Beliefs:

$$\max_{x_i^t \in X_i} \sum_{t=0}^{\infty} \delta^t \sum_{s_t \in S_t} \tilde{p}\left(s_t\right) U\left(x_i^t | s_t\right)$$

  where $\tilde{p}\left(s_t\right)$ is the subjective distribution of states S_i for agent.

- Distribution for agent differs from actual distribution: $\tilde{p}\left(s_t\right) \neq p\left(s_t\right)$

- Three main examples:

  1. *Overconfidence*. Overestimate one's own skills (or precision of estimate): $\tilde{p}\left(good\ state_t\right) > p\left(good\ state_t\right)$
  2. *Law of Small Numbers.* Gambler's Fallacy and Overinference in updating $\tilde{p}\left(s_t | s_{t-1}\right)$
  3. *Projection Bias.* Expect future utility $\widetilde{U}\left(x_i^t | s_t\right)$ to be too close to today's

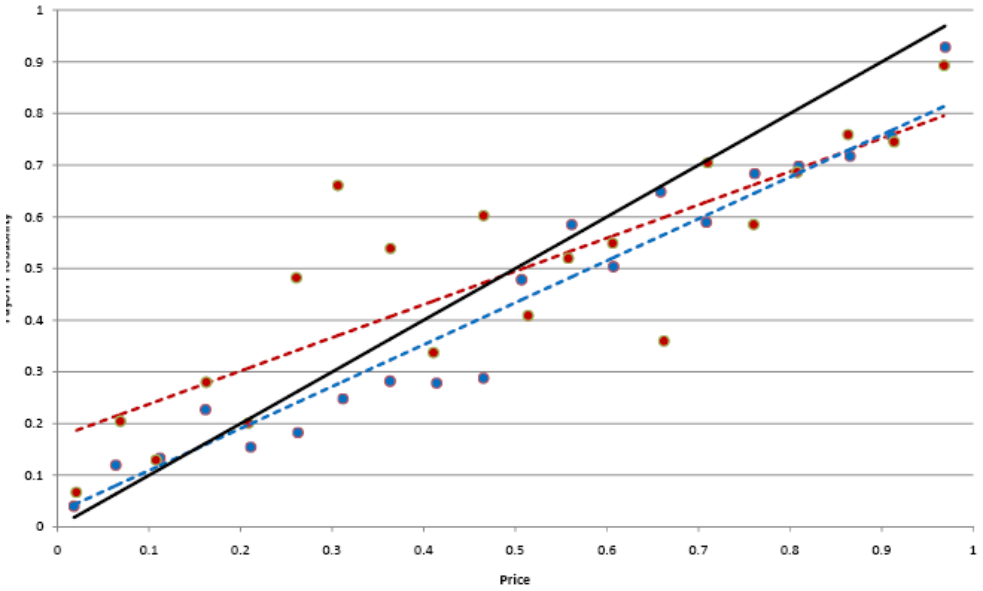
6 Overconfidence

- Overconfidence is of at least two types:
  - Overestimate one's ability (also called *overoptimism*)
  - Overestimate the precision of one's estimates (also called *overprecision*)
- Psychology: Evidence on overconfidence/overoptimism
  - **Svenson (1981):** 93 percent of subjects rated their driving skill as above the median, compared to the other subjects in the experiment
  - **Weinstein (1980):** Most individuals underestimate the probability of negative events such as hospitalization
  - **Buehler-Griffin-Ross (1994):** Underestimate time needed to finish a project

- Applications in the field of overconfidence/overoptimism
- **Example 1. Overconfidence about self-control by consumers ($\hat{\beta} > \beta$)**
  - Evidence on self-control supports idea of naiveté
    * Status-quo bias (Madrian-Shea, 1999)
    * Response to teaser rates (Ausubel, 1999)
    * Health-club behavior (DellaVigna-Malmendier, 2006)

- **Example 2. Overconfidence for employees: Cowgill and Zitzewitz (REStud 2015)**
  - Prediction markets of Google employees (with raffle tickets for total of $10,000 per quarter in payoffs)
  - Data: years 2005-2007, 1,463 employees placed $\geq$ 1 trade

Figure 2. Prices and Probabilities in Two and Five-outcome Markets



Trades in two (red) and five-outcome (blue) markets (22,452and 42,416, respectively) are sorted into 20 bins according to price (i.e., 0-5, 5-10, etc.), and then average price and payoff probability for the bin is plotted. Dashed lines plot regression equations using OLS.

- – Securities not related to Google correctly priced on average
  - – Securities with implications for Google: Substantial overconfidence for two-outcome security, Less so for five-outcome security

Table 5. Optimistic bias in the Google markets

	Obs.	Avg price	Avg payoff	Return (SE)	
All markets	70,706	0.357	0.342	-0.015***	(0.003)
Markets with implication for Google	37,910	0.310	0.293	-0.017***	(0.004)
Two-outcome markets with implication for Google	9,023	0.509	0.492	-0.017***	(0.006)
Best outcome for Google	4,556	0.456	0.199	-0.256***	(0.063)
Worst	4,467	0.563	0.790	0.227***	(0.064)
Five-outcome markets with implication for Google	26,511	0.239	0.222	-0.017***	(0.005)
Best outcome for Google	5,592	0.244	0.270	0.027	(0.040)
2nd	5,638	0.271	0.246	-0.025	(0.066)
3rd	5,539	0.296	0.179	-0.118**	(0.053)
4th	5,199	0.206	0.178	-0.028	(0.041)
Worst	4,543	0.162	0.236	0.074	(0.056)

- Survey evidence suggests phenomenon general
- **Oyer and Schaefer, 2005; Bergman and Jenter, 2007**
  - Overconfidence of employees about own-company performance is leading explanation for provision of stock options to rank-and-file employees
  - Stock options common form of compensation: (Black and Scholes) value of options granted yearly to employees in public companies over $400 (about one percent of compensation) in 1999 (Oyer and Schaefer, 2005)
  - Incentive effects unlikely to explain the issuance: contribution of individual employee to firm value very limited
  - Overconfidence about own-company performance can make stock options an attractive compensation format for employers
  - Overconfidence needs to be larger for employees than for top managers (problem set 2)

- Sorting contributes: Overconfidence plausible since workers overconfident about a company sort into it

- However, **Bergman and Jenter (2007):** employees can also purchase shares on open market, do not need to rely on the company providing them
  - Under what conditions company will still offer options to overconfident employees?
  - Also, why options and not shares in company?
  - **Bergman and Jenter (2007):** option compensation is used most intensively by company when employees more likely to be overconfident based on proxy (past returns)

- **Example 3. Overconfidence about ability by CEOs**
- **Malmendier-Tate (JF 2005 and JFE 2008)**
- Assume that CEOs overestimate their capacity to create value
- Implications for:
  - Investment decisions (MT 2005)
  - Mergers (MT 2008)
  - Equity issuance (MT 2010)
- Focus on merger implications
- Slides courtesy of Ulrike

Model

Assumptions

1. CEO acts in interest of current shareholders.
   (*No agency problem.*)

2. Efficient capital market.
   (*No asymmetric information.*)

Notation

V_A = market value of the acquiring firm
V_T = market value of the target firm
V = market value of the combined firm
$\hat{V}_A$ = acquiring CEO's valuation of his firm
$\hat{V}$ = acquiring CEO's valuation of the combined firm
c = cash used to finance the merger

Rational CEO

- Target shareholders demand share s of firm such that:

$$sV = V_T - c.$$

- CEO decides to merge if $V - (V_T - c) > V_A$ (levels).

  $\Rightarrow$ Merge if $e > 0$ (differences), where e is "synergies."

  $\Rightarrow$ First-best takeover decision.

- Post-acquisition value to current shareholders:

$$\overline{V} = V - (V_T - c) = (V_A + V_T + e - c) - (V_T - c) = V_A + e$$

$$\Rightarrow \frac{\partial \overline{V}}{\partial c} = 0 \text{ (}\textit{No financing prediction.}\text{)}$$

Overconfident CEO (I)

- CEO overestimates future returns to own firm:

$$\hat{V}_A > V_A$$

  CEO overestimates returns to merger:

$$\hat{V} - V > \hat{V}_A - V_A$$

- Target shareholders demand share s of firm such that:

$$sV = V_T - c$$

  CEO believes he should have to sell s such that:

$$s\hat{V} = V_T - c$$

Overconfident CEO (II)

- CEO decides to merge if

$$\hat{V} - (V_T - c) - \left[\frac{(\hat{V} - V)(V_T - c)}{V} \right] > \hat{V}_A \text{ (levels)},$$

i.e. merges if

$$e + \hat{e} > \left[\frac{(\hat{V}_A - V_A + \hat{e})(V_T - c)}{V} \right] \text{ (differences)},$$

where $\hat{e}$ are perceived "synergies."

Propositions

Compare

$$V(c) - (V_T - c) > V_A \quad \text{and}$$

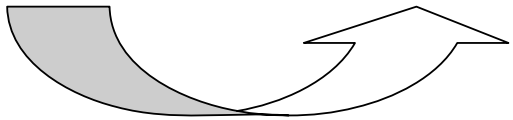
$$\widehat{V}(c) - (V_T - c) - \frac{[\widehat{V}(c) - V(c)](V_T - c)}{V(c)} > \widehat{V}_A$$

1. Overconfident managers do some value-destroying mergers. (Rational CEOs do not.)
2. An overconfident manager does more mergers than a rational manager when internal resources are readily available
3. An overconfident manager may forgo some value-creating mergers. (Rational managers do not.)

Empirical Predictions

Rational CEO

Overconfident CEO



1. On average?
2. Overconfident CEOs do more mergers that are likely to destroy value
3. Overconfident CEOs do more mergers when they have abundant internal resources
4. The announcement effect after overconfident CEOs make bids is lower than for rational CEOs

Data

Data on private accounts

1. Hall-Liebman (1998)
   Yermack (1995)

Key: Panel data on stock and option holdings of CEOs of Forbes 500 companies 1980-1994

2. Personal information about these CEOs from
   - Dun & Bradstreet
   - Who's who in finance

Data on corporate accounts

1. CRSP/COMPUSTAT

   Cash flow, Q, stock price…

2. CRSP/SDC-merger databases

   Acquisitions

Primary Measure of Overconfidence

"Longholder"

(Malmendier and Tate 2003)

CEO holds an option until the year of expiration.

CEO displays this behavior at least once during sample period.

→ minimizes impact of CEO wealth, risk aversion, diversification

Robustness Checks:

1. Require option to be at least *x*% in the money at the beginning of final year
2. Require CEO to *always* hold options to expiration
3. Compare "late exercisers" to "early exercisers"

Empirical Specification

$$\Pr\{Y_{it} = 1 \mid X, O_{it}\} = G(\beta_1 + \beta_2 \bullet O_{it} + X^T\boldsymbol{\gamma})$$

with
- i company
- t year
- Y acquisition (yes or no)
- O overconfidence
- X controls

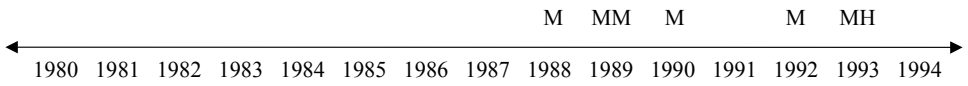
→ H_0: $\beta_2 = 0$ (overconfidence does not matter)
→ H_1: $\beta_2 > 0$ (overconfidence does matter)

Identification Strategy (I)

Case 1:

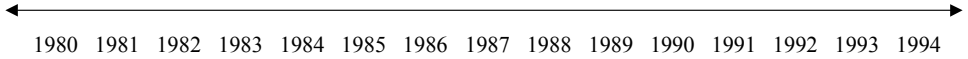
Wayne Huizenga (Cook Data Services/Blockbuster)

- CEO for all 14 years of sample
- Longholder



J Willard Marriott (Marriott International)

- CEO for all 15 years of sample
- Not a Longholder



AND

Case 2:

Colgate Palmolive

- Keith Crane CEO from 1980-1983 (Not a Longholder)
- Reuben Mark CEO from 1984-1994 (Longholder)

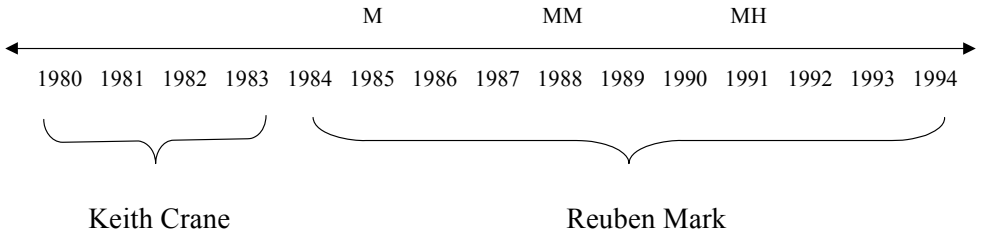


Table 4. Do Overconfident CEOs Complete More Mergers?

Longholder = holds options until last year before expiration (at least once)
Distribution: Logistic. Constant included.
Dependent Variable: Acquistion (yes or no)**; Normalization:** Capital.

	logit with controls	random effects logit	logit with fixed effects
Size	**0.8733**	**0.8600**	**0.6234**
	(1.95)*	(2.05)**	(2.60)***
Q_{t-1}	**0.7296**	**0.7316**	**0.8291**
	(2.97)***	(2.70)***	(1.11)
Cash Flow	**2.0534**	**2.1816**	**2.6724**
	(3.93)***	(3.68)***	(2.70)***
Ownership	**1.2905**	**1.3482**	**0.8208**
	(0.30)	(0.28)	(0.11)
Vested Options	**1.5059**	**0.9217**	**0.2802**
	(1.96)*	(0.19)	(2.36)**
Governance	**0.6556**	**0.7192**	**1.0428**
	(3.08)***	(2.17)**	(0.21)
Longholder	**1.5557**	**1.7006**	**2.5303**
	(2.58)***	(3.09)***	(2.67)***
Year Fixed Effects	yes	yes	yes
Observations	3690	3690	2261
Firms		327	184

Table 6. Are Overconfident CEOs Right to Hold Their Options? (I)

Returns from exercising 1 year sooner and investing in the S&P 500 index	
Percentile	Return
10th	-0.24
20th	-0.15
30th	-0.10
40th	-0.05
50th	-0.03
60th	0.03
70th	0.10
80th	0.19
90th	0.39
Mean	0.03
Standard Deviation	0.27
All exercises occur at the maximum stock price during the fiscal year	

Alternative Explanations

1. Inside Information or Signalling
   - Mergers should "cluster" in final years of option term
   - Market should react favorably on merger announcement
   - CEOs should "win" by holding

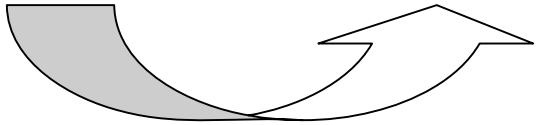
2. Stock Price Bubbles
   - Year effects already removed
   - All cross-sectional firm variation already removed
   - Lagged stock returns should explain merger activity

3. Volatile Equity

4. Finance Training

Empirical Predictions

Rational CEO	Overconfident CEO



1. On average?
2. Overconfident CEOs do more mergers that are likely to destroy value
3. Overconfident CEOs do more mergers when they have abundant internal resources
4. The announcement effect after overconfident CEOs make bids is lower than for rational CEOs

Table 8. Diversifying Mergers

Longholder = holds options until last year before expiration (at least once)
Distribution: Logistic. Constant included; **Normalization:** Capital.
Dependent Variable: Diversifying merger (yes or no).

	logit	logit with random effects	logit with fixed effects
Longholder	**1.6008**	**1.7763**	**3.1494**
	(2.40)**	(2.70)***	(2.59)***
Year Fixed Effects	yes	yes	yes
Observations	3690	3690	1577
Firms		327	128

Dependent Variable: Intra-industry merger (yes or no).

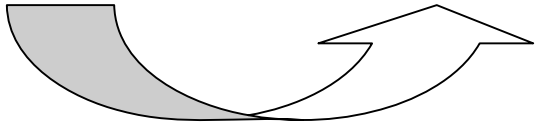
Longholder	**1.3762**	**1.4498**	**1.5067**
	(1.36)	(1.47)	(0.75)
Year Fixed Effects	yes	yes	yes
Observations	3690	3690	1227
Firms		327	100

Regressions include Cash Flow, Q_{t-1}, Size, Ownership, Vested Options, and Governance. Industries are Fama French industry groups.

Empirical Predictions

Rational CEO

Overconfident CEO



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Kaplan-Zingales Index

$$KZ = -1.00 \cdot \frac{CashFlow}{Capital} + 0.28 \cdot Q + 3.14 \cdot Leverage - 39.37 \cdot \frac{Dividends}{Capital} - 1.31 \cdot \frac{Cash}{Capital}$$

- Coefficients from logit regression (Pr{financially constrained})
- High values ⟶ Cash constrained
  - Leverage captures debt capacity
  - Deflated cash flow, cash, dividends capture cash on hand
  - Q captures market value of equity (Exclude?)

Table 9. Kaplan-Zingales Quintiles

Longholder = holds options until last year before expiration (at least once)
Distribution: Logistic. Constant included.
Dependent Variable: Acquistion (yes or no)**; Normalization:** Capital.
All regressions are logit with random effects.

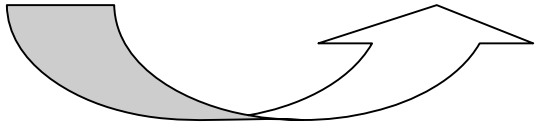
	Least Equity Dependent		---------->		Most Equity Dependent
			All Mergers		
	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Longholder	**2.2861**	**1.6792**	**1.7756**	**1.9533**	**0.8858**
	(2.46)**	(1.48)	(1.54)	(1.50)	(0.33)
Year Fixed Effects	yes	yes	yes	yes	yes
Observations	718	719	719	719	718
Firms	125	156	168	165	152
			Diversifying Mergers		
	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Longholder	**2.5462**	**1.8852**	**1.7297**	**1.0075**	**1.0865**
	(1.89)*	(1.51)	(1.36)	(0.01)	(0.18)
Year Fixed Effects	yes	yes	yes	yes	yes
Observations	718	719	719	719	718
Firms	125	156	168	165	152

Regressions include Cash Flow, Q_{t-1}, Size, Ownership, Vested Options, and Governance.

Empirical Predictions

Rational CEO

Overconfident CEO



1. On average?
2. Overconfident CEOs do more mergers that are likely to destroy value
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4. The announcement effect after overconfident CEOs make bids is lower than for rational CEOs

Empirical Specification

$$CAR_i = \beta_1 + \beta_2 \bullet O_i + X'\gamma + \varepsilon_i$$

with i company

O overconfidence

X controls

$$CAR_i = \sum_{t=-1}^{1} \left(r_{it} - E[r_{it}] \right)$$

where $E[r_{it}]$ is daily S&P 500 returns (α=0; β=1)

Table 14. Market Response

Longholder = holds options until last year before expiration (at least once)
Dependent Variable: Cumulative abnormal returns [-1,+1]

	OLS (3)	OLS (4)	OLS (5)
Relatedness	**0.0048**	**0.0062**	**0.0043**
	(1.37)	(1.24)	(1.24)
Corporate Governance	**0.0079**	**0.0036**	**0.0073**
	(2.18)**	(0.64)	(1.98)**
Cash Financing	**0.014**	**0.0127**	**0.0145**
	(3.91)***	(2.60)***	(3.99)***
Age			**-0.0005**
			(1.46)
Boss			**0.0001**
			(0.04)
Longholder	**-0.0067**	**-0.0099**	**-0.0079**
	(1.81)*	(2.33)**	(2.00)**
Year Fixed Effects	yes	yes	yes
Industry Fixed Effects	no	yes	no
Industry*Year Fixed Effects	no	yes	no
Observations	687	687	687
R-squared	0.10	0.58	0.10

Regressions include Ownership and Vested Options.

Do Outsiders Recognize CEO Overconfidence?

Portrayal in Business Press:

1. Articles in
   - New York Times
   - Business Week
   - Financial Times
   - The Economist
   - Wall Street Journal
2. Articles published 1980-1994
3. Articles which characterize CEO as
   - Confident or optimistic
   - Not confident or not optimistic
   - Reliable, conservative, cautious, practical, steady or frugal

Table 13. Press Coverage and Diversifying Mergers

Distribution: Logistic. Constant included; **Normalization:** Capital. **Dependent Variable:** Diversifying merger (yes or no).	logit	logit with random effects	logit with fixed effects
TOTALconfident	**1.6971**	**1.7826**	**1.5077**
	(2.95)***	(3.21)***	(1.48)
Year Fixed Effects	yes	yes	yes
Observations	3647	3647	1559
Firms		326	128
Dependent Variable: Intra-industry merger (yes or no).			
TOTALconfident	**1.0424**	**1.0368**	**0.8856**
	(0.20)	(0.16)	(0.31)
Year Fixed Effects	yes	yes	yes
Observations	3647	3647	1226
Firms		326	100
Regressions include Total Coverage, Cash Flow, Q_{t-1}, Size, Ownership, Vested Options, and Governance. Industries are Fama French industry groups.			

- Overconfidence/Overprecision: Overestimate the precision of one's estimates
- **Alpert-Raiffa (1982).** Ask questions such as
  - 'The number of "Physicians and Surgeons" listed in the 1968 Yellow Pages of the phone directory for Boston and vicinity'
  - 'The total egg production in millions in the U.S. in 1965.'
  - 'The toll collections of the Panama Canal in fiscal 1967 in millions of dollars'
- Ask for 99 percent confidence intervals for 1,000 questions
- No. of errors: 426! (Compare to expected 20)
- (Issue: Lack of incentives)

- **Investor Overconfidence: Odean (1999)**
- Investor overconfidence/overprecision predicts excessive trading
  - investor believes signal is too accurate –> Executes trade
- Empirical test using data set from discount brokerage house
- Follow all trades of 10,000 accounts
- January 1987-December 1993
- 162,948 transactions

- Traders that overestimate value of their signal trade too much
- Substantial cost for trading too much:
  - Commission for buying 2.23 percent
  - Commission for selling 2.76 percent
  - Bid-ask spread 0.94 percent
  - Cost for 'round-trip purchase': 5.9 percent (!)

- Stock return on purchases must be at least 5.9 percent.
- Compute buy-and-hold returns
- Evidence: Sales outperform purchases by 2-3 percent!

TABLE 1—AVERAGE RETURNS FOLLOWING PURCHASES AND SALES

Panel A: All Transactions

	n	84 trading days later	252 trading days later	504 trading days later
Purchases	49,948	1.83	5.69	−24.00
Sales	47,535	3.19	9.00	27.32
Difference		−1.36	−3.31	−3.32
N1		(0.001)	(0.001)	(0.001)
N2		(0.001)	(0.001)	(0.002)

- Is the result weaker for individuals that trade the most? No

Panel C: The 10 Percent of Investors Who Trade the Most				
	n	84 trading days later	252 trading days later	504 trading days later
Purchases	29,078	2.13	7.07	25.28
Sales	26,732	3.04	9.76	28.78
Difference		−0.91	−2.69	−3.50
N1		(0.001)	(0.001)	(0.001)
N2		(0.001)	(0.001)	(0.010)

- Huge cost to trading for individuals:
  - Transaction costs
  - Pick wrong stocks

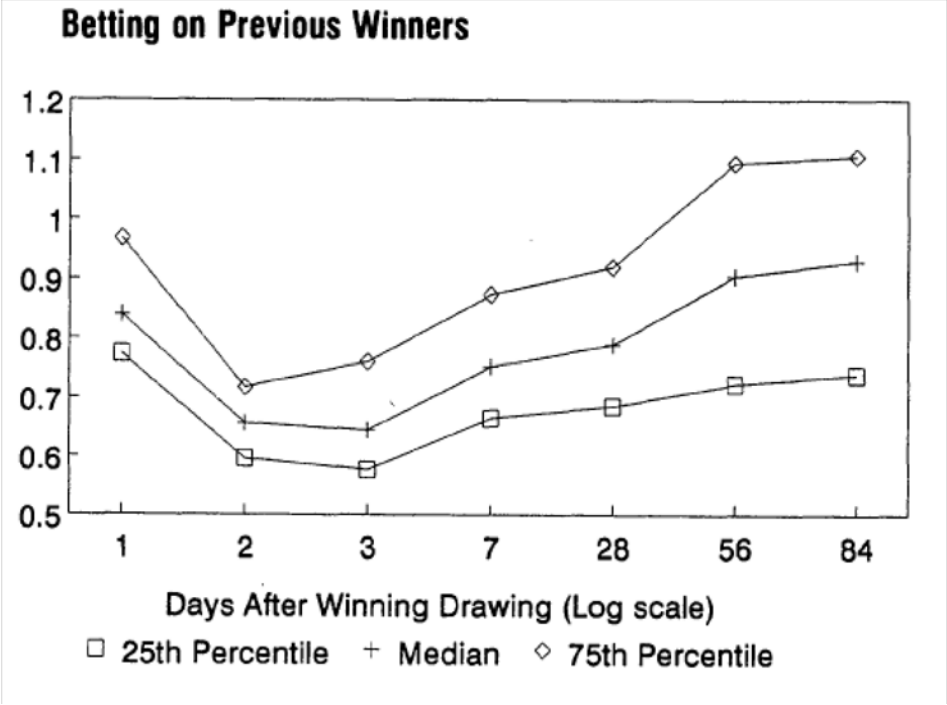
- Overconfidence/overprecision can explain other puzzles in asset pricing:
  - short-term positive correlation of returns (momentum)
  - long-term negative correlation (long-term reversal)
- **Daniel-Hirshleifer-Subrahmanyam (1998)**
- Assume overconfidence + self-attribution bias (discount information that is inconsistent with one's priors)
  - Overconfidence –> trade excessively in response to private information
  - Long-term: public information prevails, valuation returns to fundamentals –> long-term reversal
  - Short-term: additional private information interpreted with self-attribution bias –> become even more overconfident
- Two other explanations for this: Law of small numbers + Limited attention

7 Law of Small Numbers

- Overconfidence is only one form of non-Bayesian beliefs
- **Tversky-Kahneman (1974).** Individuals follow heuristics to simplify problems:
  - *Anchoring.* –> Leads to over-precision (above)
  - *Availability.* –> Connected to limited attention (next lecture)
  - *Representativeness.* –> Today's lecture
- Individuals expect random draws to be exceedingly representative of the distribution they come from
  - HTHHTT judged more representative than HHHTTT
  - But the two are equally likely! (exchangeability)

- **Rabin (QJE, 2002). Law of Small Numbers**
  - I.i.d. signals from urn drawn with replacement
  - Subjects instead believe drawn from an urn of size $N < \infty$ without replacement
  - –> *Gambler's Fallacy:* After signal, subject expect next draw to be a different signal
  - Example: Return to mutual fund is drawn from an urn with 10 balls, 5 Up and 5 Down (with replacement)
  - Observe 'Up, Up' — Compute probability of another Up
    - Bayesian: .5
    - Law of Small Numbers: $3/8 < .5$
  - Example of representativeness: 'Up, Up, Down' more representative than 'Up, Up, Up'

- Evidence on gambler's fallacy.
- **Clotfelter and Cook (MS, 1993)**
- Lotteries increasingly common in US ($17bn sales in 1989)
- Maryland daily-numbers lottery –> Bet on 3-digit number
  - Probability of correct guess .001
  - Payout: $500 per $1 bet (50 percent payout)
- Gambler's Fallacy –> Betters will stop betting on number just drawn
  - Examine 52 winning numbers in 1988
  - In 52 of 52 cases (!) betting volume decreases 3 days after win, relative to baseline



- – Substantial decrease in betting right after number is drawn
  - – Effect lasts about 3 months
  - – However: no cost for fallacy –> Does effect replicate with cost?

- **Terrell (JRU, 1994)**
- New Jersey's pick-three-numbers game (1988-1992)
- Pari-mutuel betting system
  - the fewer individuals bet on a number, the higher is the expected payout
  - Cost of betting on popular numbers
  - Payout ratio .52 –> Average win of $260 for 50c bet
- Issue: Do not observe betting on all numbers –> Use payout for numbers that repeat

Table 1. Average payouts to winning numbers

	Number	Mean	Standard deviation
Winners repeating within 1 week	8	349.06	91.66
Winners repeating between 1 and 2 weeks	8	349.44	81.56
Winners repeating between 2 and 3 weeks	14	307.76	58.33
Winners repeating between 3 and 8 weeks	59	301.03	70.55
Winners not repeating within 8 weeks	1622	260.11	57.98
All Winners	1714	262.79	57.99

- Strong gambler's fallacy:
  - Right after win, 34 percent decrease in betting
  - –> 34 percent payout increase
  - Effect dissipates over time

- Comparison with Maryland lottery:
  - Smaller effect (34 percent vs. 45 percent)
  - –> Incentives temper phenomenon, but only partially
- Other applications:
  - Probabilities are known, but subjects misconstrue the i.i.d. nature of the draws.
  - Example: Forecast of the gender of a third child following two boys (or two girls)

- Back to **Rabin (QJE, 2002)**.
  - Probabilities known –> Gambler's Fallacy
  - Probabilities not known –> Overinference: After signals of one type, expect next signal of *same* type
- Example:
  - Mutual fund with a manager of uncertain ability.
  - Return drawn with replacement from urn with 10 balls
    - Probability .5: fund is well managed (7 balls Up and 3 Down)
    - Probability .5: fund is poorly managed (3 Up and 7 Down)
  - Observe sequence 'Up, Up, Up' –> What is $P(Well|UUU)$?
    - Bayesian: $P(Well|UUU) = .5P(UUU|Well)/[.5P(UUU|Well)+ .5P(UUU|Poor)] = .7^3/\left(.7^3+.3^3\right) \approx .927.$

  - * Law-of-Small-Number: $P(Well|UUU) = (7/10{*}6/9{*}5/8)/[(7/10{*}6/9*5/8) + (3/10*2/9*1/8)] \approx .972$.
  - * Over-inference about the ability of the mutual-fund manager
  - Also assume:
    - * Law-of-Small-Number investor believes that urn replenished after 3 periods
    - * Need re-start or
  - What is Forecast of $P(U|UUU)$?
    - * Bayesian: $P(U|UUU) = .927*.7 + (1-.927)*.3 \approx .671$
    - * Law-of-Small-Number: $P(U|UUU) = .972{*}.7 + (1-.972){*}.3 \approx .689$
- Over-inference despite the gambler's fallacy beliefs

- Substantial evidence of over-inference (also called extrapolation)
- Notice: Case with unknown probabilities is much more common than lottery case
- Excellent review: **Fuster, Laibson, and Mendel (JEP 2010)**
- **Benartzi (JF, 2001)**
  - Examine investment of employees in employer stock
  - Does it depend on the past performance of the stock?
- Sample:
  - S&P 500 companies with retirement program
  - Data from 11-k filing
  - 2.5 million participants, $102bn assets

Buy-and-Hold Raw Returns and Subsequent Allocations to Company Stock as a Percentage of Discretionary Contributions

This table displays equally weighted mean allocations to company stock (as a percentage of discretionary contributions) by quintile of past buy-and-hold raw returns. Company stock allocations are measured at the end of 1993. Portfolio 1 (5) includes retirement savings plans with the lowest (highest) past buy-and-hold raw returns. The table also provides the difference between the allocations of the extreme portfolios (i.e., portfolio 5 minus portfolio 1) and *t*-statistics. $N = 142$.

Quintiles Formed on the Basis of Buy-and-Hold Raw Returns for:	Quintile of Buy-and-Hold Returns					Observed Difference	
	(Low) 1	2	3	4	5 (High)	(5 − 1)	*T*-Statistic
Prior year	21.10%	23.16%	27.85%	25.99%	23.70%	2.60%	0.60
Prior 2 years	22.61	22.43	25.18	28.74	22.96	0.35	0.06
Prior 3 years	14.14	25.45	26.21	28.84	27.78	13.64	3.33
Prior 4 years	11.74	22.20	28.18	31.10	30.23	18.49	4.64
Prior 5 years	12.64	18.68	26.27	34.66	31.21	18.57	4.33
Prior 6 years	11.99	18.72	29.33	33.45	29.96	17.97	4.63
Prior 7 years	11.36	18.98	24.11	34.79	33.70	22.34	5.87
Prior 8 years	11.46	20.69	24.22	32.96	33.63	22.17	5.70
Prior 9 years	11.08	20.76	20.52	34.04	36.68	25.60	6.49
Prior 10 years	10.37	19.68	21.56	31.51	39.70	29.33	8.39

- Very large effect of past returns + Effect depends on long-term performance

- Is the effect due to inside information?

	Allocation to Company Stock					Observed Difference (5 − 1)	Threshold for Significant Difference at $\alpha = 10\%$
	(Low) 1	2	3	4	5 (High)		
Allocation to company stock as a percentage of discretionary contributions	4.59%	12.19%	19.34%	31.85%	53.90%	49.41%	
One-year returns	6.64	6.55	1.27	−1.03	0.13	−6.77	7.12
Two-year returns	43.69	40.78	38.24	43.33	31.92	−11.77	14.75
Three-year returns	59.29	70.28	68.64	79.66	56.25	−3.04	21.99
Four-year returns	101.08	114.55	109.89	149.92	103.14	2.06	36.15

- No evidence of insider information
- Over-inference pattern observed for investors of all types

- Over-inference pattern observed for investors of all types
- **Barber-Odean-Zhou (JFE, forthcoming):** Uses Individual trades data
  - Individual US investors purchase stocks with high past returns
  - Average stock that individual investors purchase outperformed the stock market in the previous three years by over 60 percent
- **Kaustia and Knupfer (JF 2008)**
  - Use Finnish data to be able to track individual investors over time
  - Examine investors that subscribe to an IPO in a 1st period, 1995-Oct. 1999
  - Return is highly idyosincratic
  - Indeed, Figure 1 shows no predictability on returns in second period: Nov. 1999-Dec. 2000

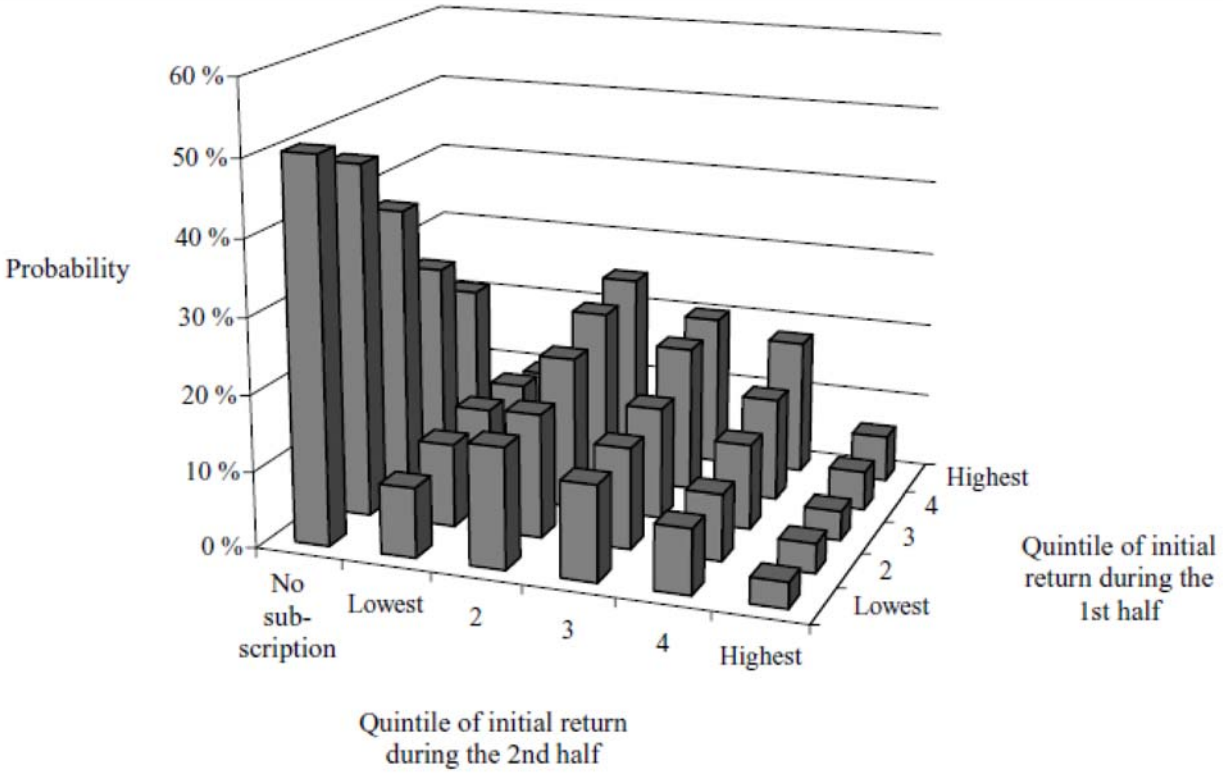


Figure 1. Transition probabilities between previous and subsequent initial return quintiles. To obtain the figure, the sample period is divided into two halves. The first half has 40 IPOs, the last occurring in October 22, 1999; the second half has 17 offerings, the last in December 20, 2000. This split is determined by placing an equal number of investor/offering pairs in both periods.

- What about probability of subscribing to IPOs in second period?

- Strong effect of personally experience returns

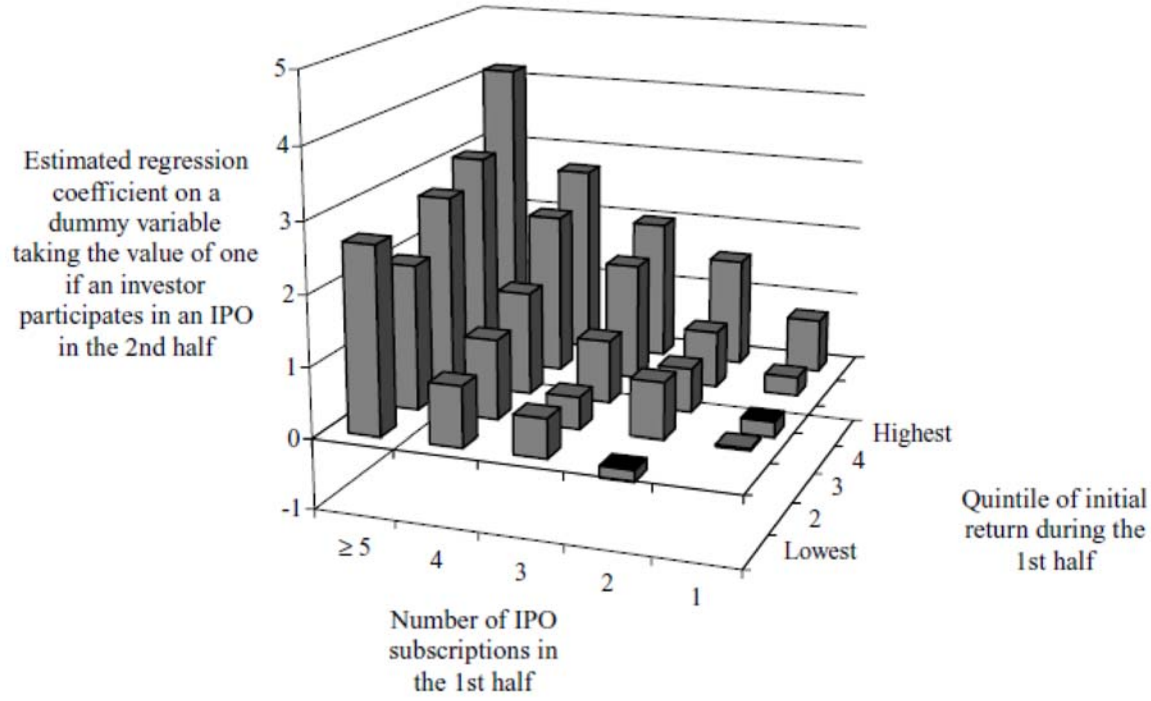


Figure 2. Likelihood of further participation by past subscription activity and past initial returns. This figure is based on a logit regression similar to that in Table II column 1, that is, the dependent variable is one if an investor participates in at least one IPO in the second half, zero otherwise (see more description in Table II header). Unlike in Table II, here previous

- This implies effect on pricing:
  - Stocks with high past returns attract individual investors
  - –> Get overpriced
  - –> Later mean-revert
- **DeBondt and Thaler (1985):**
  - Form portfolio of winners in the past 3 years
  - Form portfolio of losers in past 3 years.
  - 'Winners' underperform the 'losers' by 25 percentage points over the next three years

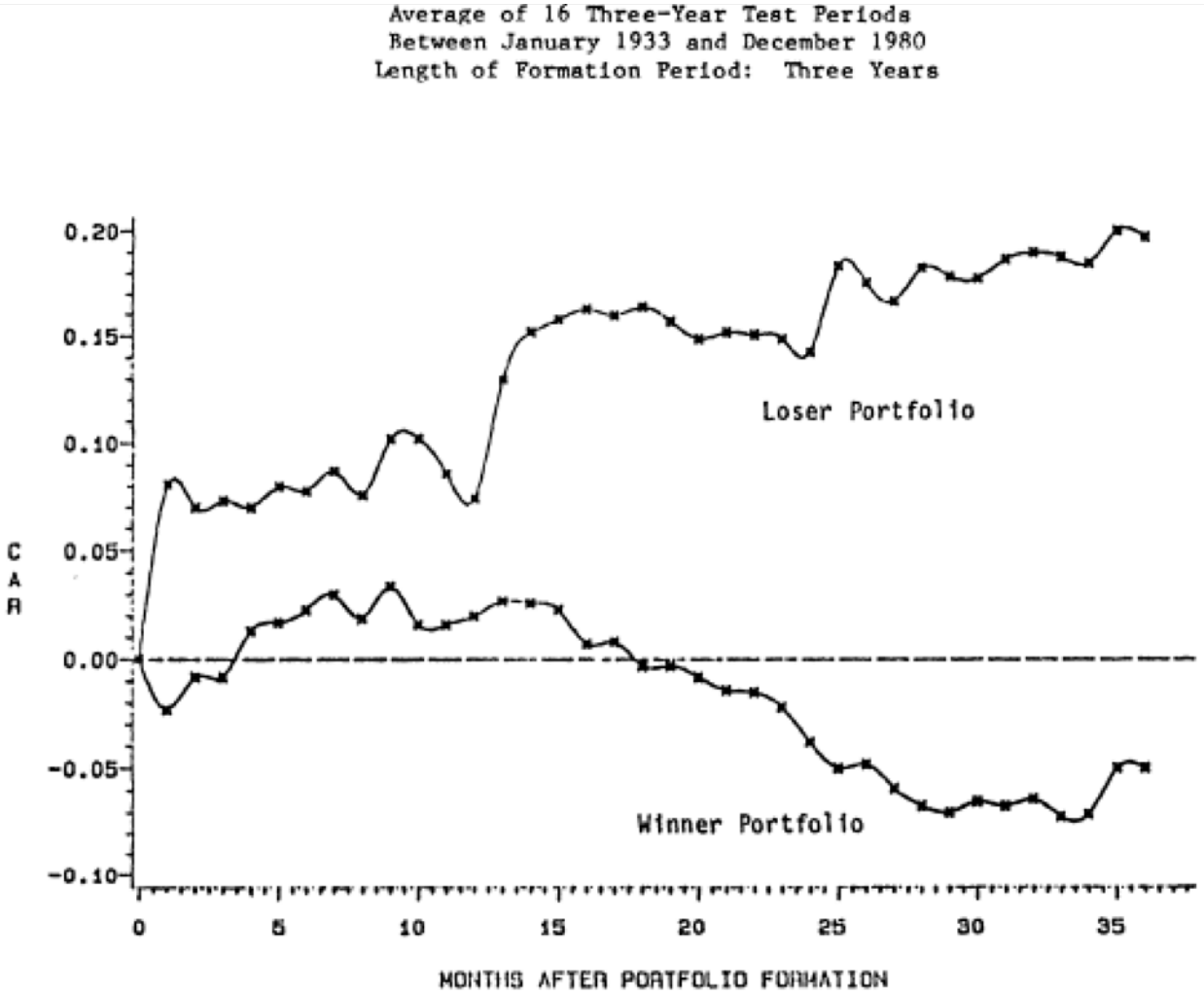


Figure 1. Cumulative Average Residuals for Winner and Loser Portfolios of 35 Stocks (1–36 months into the test period)

- **Barberis-Shleifer-Vishny (JFE, 1998)**
  - Alternative model of law of small number in financial markets.
  - Draws of dividends are i.i.d.
  - Investors believe that
    * draws come from 'mean-reverting' regime or 'trending' regime
    * 'mean-reverting' regime more likely ex ante
  - Result: If investors observe sequence of identical signals,
    * Short-Run: Expect a mean-reverting regime (the gambler's fallacy) –> Returns under-react to information –> Short-term positive correlation (momentum)
    * Long-run: Investors over-infer and expect a 'trending' regime –> Long-term negative correlation of returns

- Extrapolation also in other contexts
- **Gallagher (AEJ Applied 2014)**
  - Consider idiosincratic flood events
  - Largely uncorrelated from year to year
  - Statistical information on flood probabilities available
  - What is the effect of a recent flood?
  - Large increase in probability of insurance
- Effect is present also for communities not directly hit
- What explains the effect? Media salience is critical

Figure 2: Flood Insurance Take-up for Communities Hit by a Presidential Disa
Declaration Flood 1990-2007

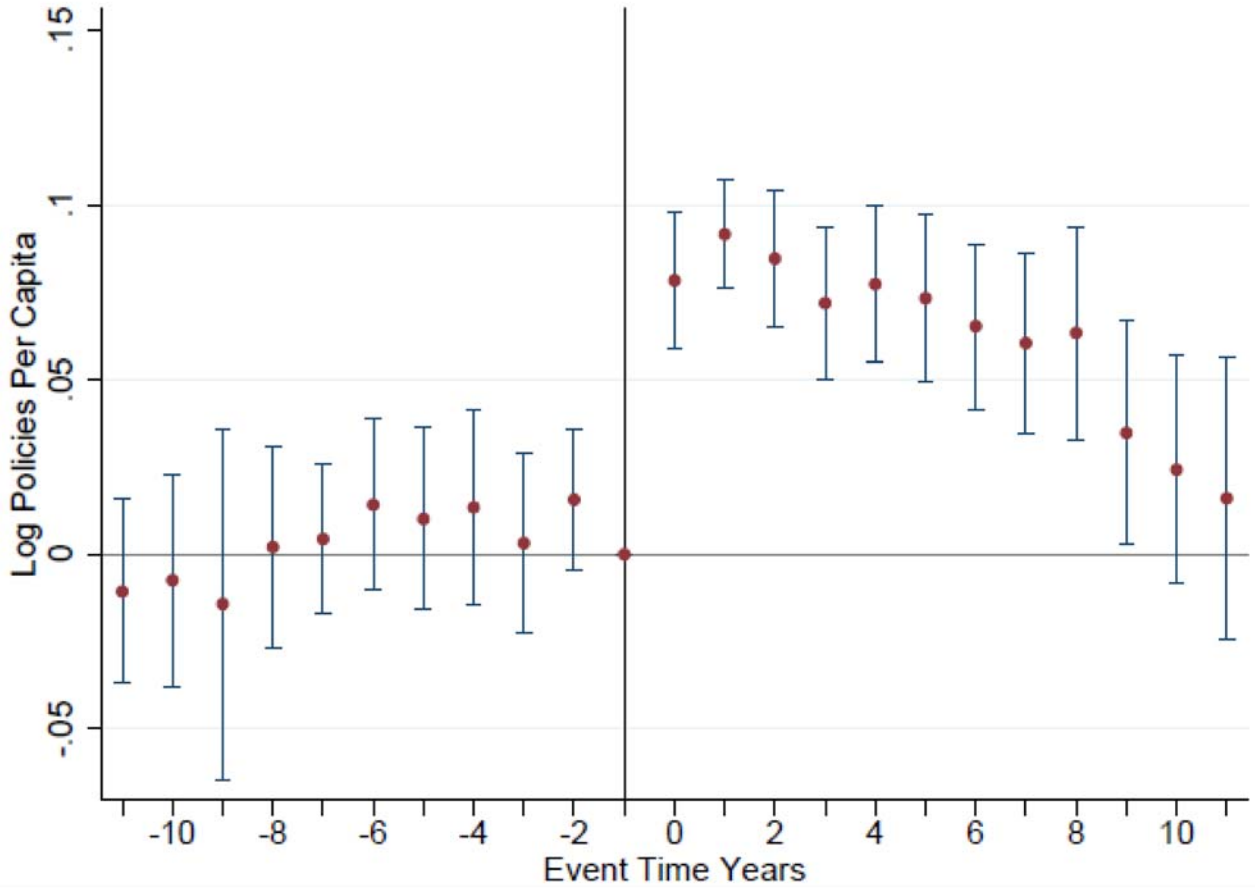


Figure 3: Flood Insurance Take-up for Hit and Non-Hit Communities within Presidential Disaster Declaration Flooded Counties 1990-2007

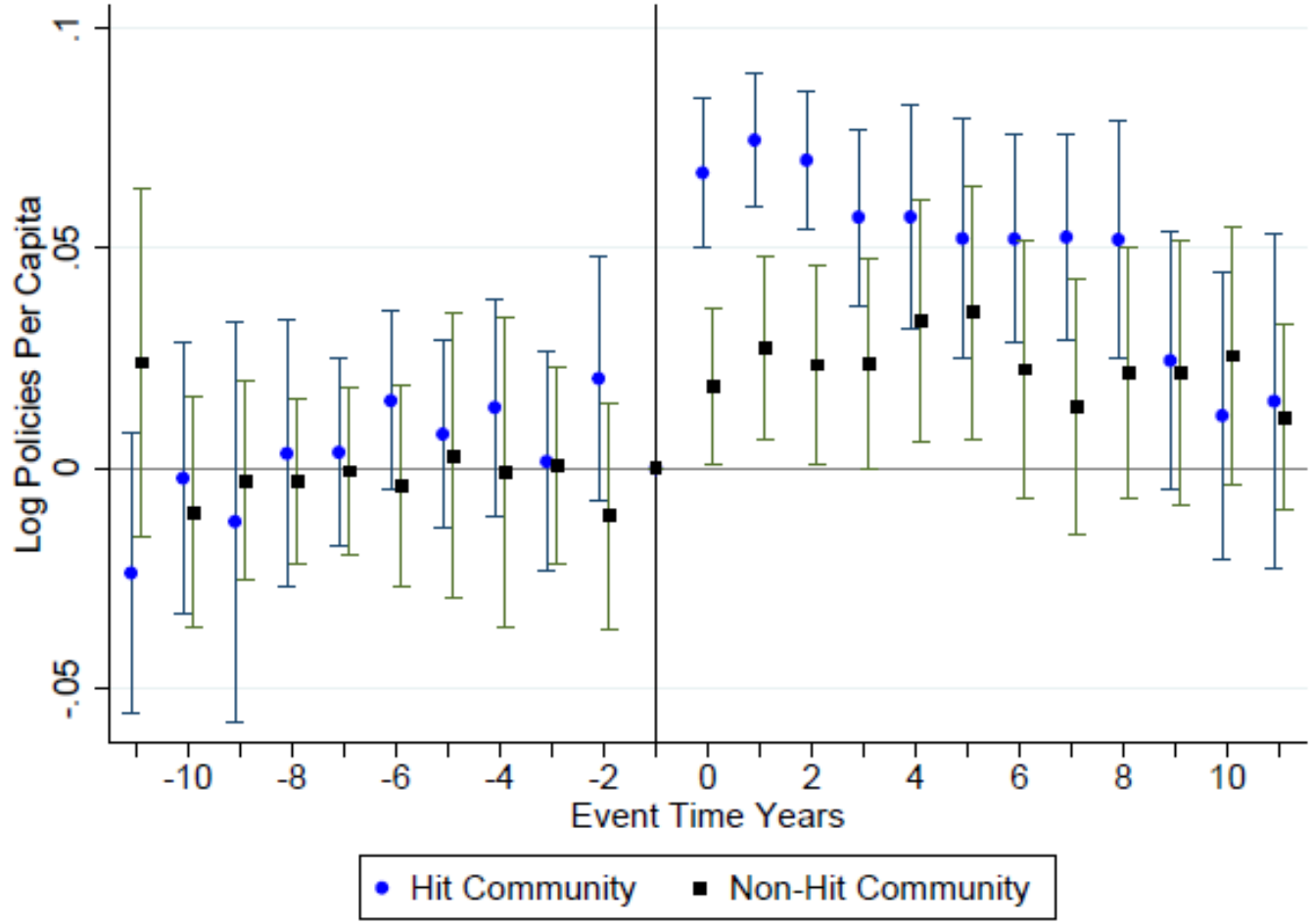
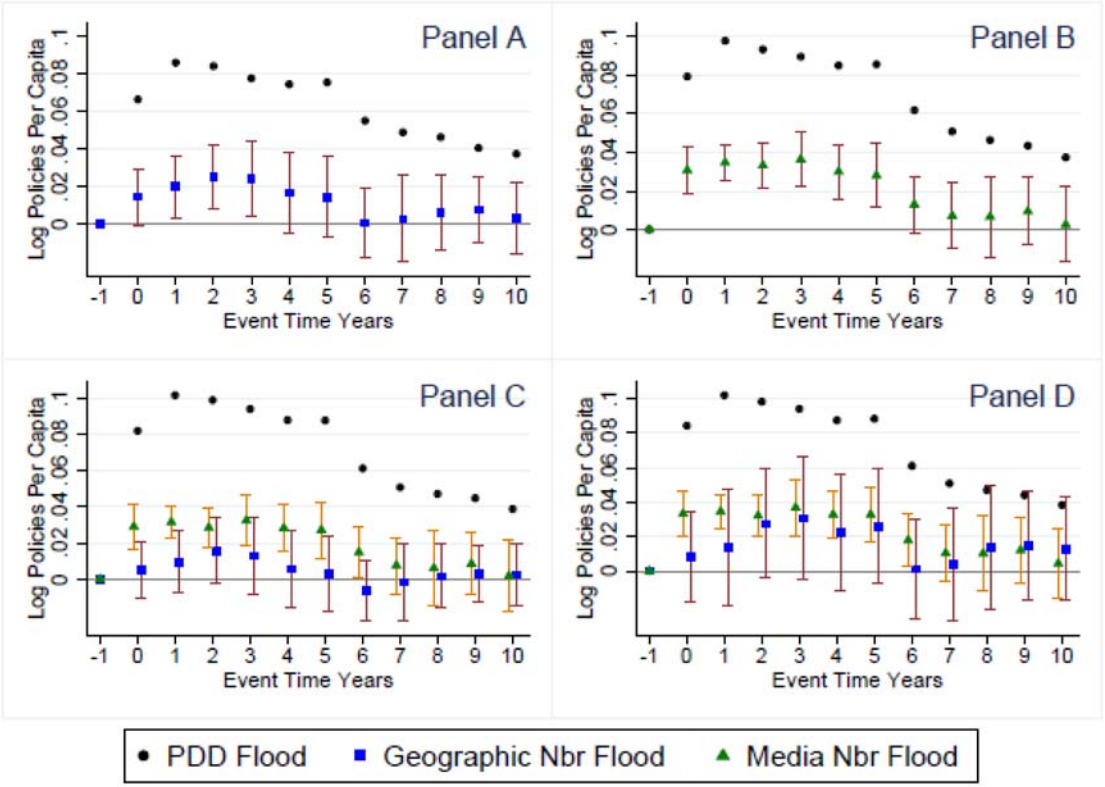


Figure 8: Flood Insurance Take-up for Geographic and Media Neighbors



Each panel contains coefficients from a distinct event study regression using a version of Equation (2) and the 1980-2007 panel. Panel A includes event time indicators for communities located in one of the five closest non-flooded counties. Panel B includes event time indicators for non-flooded communities located in the same TV media market as a flooded community. Panel C includes both geographic and media indicators. Panel D includes both geographic and media indicators, and their interaction (not displayed).

8 Next Lecture

- Law of Small Numbers
- Projection Bias
- Non-Standard Decision-Making
- Limited Attention